Assumptions of Twentieth-Century Science: A Critique

M.G. Jackson

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TWENTIETH-CENTURY SCIENTIFIC ASSUMPTIONS

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PREFACE

We all make assumptions in our everyday lives. Without them we would not be able to function at all. Some assumptions prove misleading and are quickly abandoned, while others are more serviceable and hence enduring. Even the latter, however, usually have a definite life-span. With changing circumstances, they become irrelevant and often counter-productive. Even shared cultural assumptions which may remain relevant for centuries, being handed down from one generation to the next, have often to be given up. Giving up such assumptions is difficult because we do not know that we are making them; we see them simply as descriptions of the way the world 'really' is. Being forced to abandon such out-of-date and counter-productive cultural assumptions can be extremely unsettling, creating acute insecurity. Formulating alternative assumptions is arduous and not always successful.

To be successful in letting go of existing assumptions and formulating alternatives, it is necessary to proceed systematically. First, our current assumptions must be identified. Next, reasons why we (or our ancestors) assumed them in the first place must be discovered by patient research. This done, they must be subjected to a rigorous critique in terms of their logic, their congruence with all the other assumptions we concurrently make, and their usefulness in a contemporary context. If they are found wanting, they must be dropped. But before they can be dropped alternative

assumptions that we think will be more effective must be formulated to replace them. With long-standing cultural assumptions, it will usually be necessary to replace the entire constellation of assumptions in which they participate. Judging new assumptions for their suitability thus requires both circumspection and attention to detail.

And so it is also with scientists in their professional work. When it began to be apparent in the 14th century that the inherited assumptions of Aristotelian science were inadequate, European science entered a period of some three centuries of confusion and controversy. Those scientists to whom these inadequacies became apparent struggled mightily to transform their thinking - that is, to drop existent assumptions and formulate alternatives. They succeeded in large measure. By the end of the 17th century a fairly broad consensus emerged on a new set of assumptions.[1] For three centuries their work seemed to be vindicated in the technologies and organisational models this new science gave rise to. But in the 20th century, this 17th-century science began to unravel. Of course world conditions had changed dramatically over these past three centuries, but in addition, it is abundantly clear in retrospect that the assumptions these 17th-century pioneers made were logically flawed. Newton, for example, assumed the concept of gravitational force, even though he admitted that it made no sense.

> That gravity should be inanimate, inherent, and essential to matter, so that one body may act upon another, at a distance through a vacuum, without the mediation of anything else, by and through which their action and force may be conveyed from one to

[1] Arthur Koestler has given a comprehensive and detailed example of this process as it occurred in the field of astronomy during this period (Koestler, 1959).

> another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into it.
>
> Isaac Newton (Quoted by Koestler, 1959, p.344)

In order to overcome the shortcomings of the Aristotelian explanation of the motions of terrestrial physical entities, Galileo arbitrarily, it seems, assumed that these entities possessed something he termed inertia. He also assumed that physical events can be completely explained as being the results of single-factor causal connections, provided 'ideal conditions' are visualised, though he knew that such conditions never obtain in nature and cannot be created even in the laboratory. Darwin suggested that radical generational differences in the forms and behaviour of plants and animals occur by chance - which is no better, he admitted, than saying 'I don't know'.[2] All these assumptions entered mainstream science creating problems for succeeding generations of scientists, and negative consequences for nature and society.

During the 20th century many scientists struggled to free themselves from the assumptions they inherited from the scientists of the 17th century and to formulate alternatives. They were liable to the same mistakes that 17th-century scientists had made. A critical review of the history of 20th-century science, which this book attempts, reveals that some of the same mistakes were indeed made. But it also turns up examples of numerous individuals and groups who avoided making them. It is our task in the present century to seize these more hopeful initiatives and build on them.

The set of assumptions, or worldview, that guides the work of scientists is that of the culture and cultural era in which they

---

[2] 'Not that this notion [of chance] at all satisfies me. I feel most deeply that the whole subject is too profound for the human intellect.' (Charles Darwin, quoted by Stone, 1982, p. 642)

work. Scientists contribute, as a result of their work, to the creation of that shared worldview, but like everyone else in that era, are guided by it. The work of scientists must be seen as legitimate by other scientists and by the society in which they work. Thus when we speak of 'the assumptions scientists make', we are really referring to the assumptions that everyone in that cultural era makes.

A survey of the worldviews of the major cultures and cultural eras of the past reveals a limited number of common notions, though these notions are formulated variously. The notions are universal, while the assumptions which exemplify them are culture-specific. Examples of such general notions are 'actual entities' (or what actually, finally exists), the 'I' who experiences these entities, 'time', 'space', 'life', 'causation' and 'knowing'.

When the assumptions of a given worldview have been identified and listed out, we may proceed to critique them in terms of their logical structure, their plausibility, and their logical 'fit' in the worldview in which they are placed. Finally, the relevance of the worldview as a whole to current experience must be assessed. Where it is apparent that a given assumption in the worldview under review is inadequate and we are required to formulate a new assumption to replace it, we should first of all consider analogous assumptions in other worldviews, both past and present. It will often be found that one of these other assumptions will serve our purpose, though probably only after it is rephrased in a contemporary idiom.

Several terms in the title of this book need to be defined. A 'critique' is an analysis and evaluation of a proposition or assertion in terms of its logic, its believability, and its logical compatibility with other assumptions concurrently made. Here it is the various assumptions that modern scientists make that are being critiqued. It must clearly be understood that this critique is not of the methods and results of scientific research in the 20th century, but of the

assumptions underlying and justifying these. If the assumptions are faulty the methods employed are apt to be irrelevant and the results counter-productive.

An 'assumption' is an attempt to explain why an entity or event appears as it does and not otherwise, or indeed why it appears at all. It has not been, and cannot be, verified by recourse to the concrete experience of those entities or events. It seems likely, but can never be certain. An 'event' is the appearance of an entity or the interactions of particular entities in a series of appearances of entities leading to a definite outcome. An 'experience' (noun) is the result of an interaction of an experiencing subject and an experienced entity. The experienced entity becomes known by the subject. This 'coming to know' is 'experiencing' (verb).

A worldview is a way of looking at the collectivity of the entities and events that are experienced by a person. What is experienced by a person is determined by his or her way of looking. This 'way of looking' is shared by the members of a particular culture or cultural era. More precisely, it is a set of shared assumptions that people use to describe and explain the phenomena they experience.

A scientific 'protocol' is a set of general guidelines for conducting scientific research derived from the worldview prevailing in the culture/ cultural era in which research is conducted. Following such guidelines ensures that the results of research will be accepted as valid scientific knowledge. These guidelines are usually not articulated as definite propositions, but are embodied in model research projects and programmes. It is, however, possible to formulate such propositions, and, indeed, I will argue that it is essential to do so.

This is the last of several books I have written over the past decade enquiring into the shortcomings of modern Western

civilisation, now configured as globalisation and modernisation. It should logically have been the first, but has been the most difficult to write and I kept putting off the attempt to do so. But the challenge dogged me, and realising that if I did not make the effort now, the job might never be done – at least not in the way I envisaged that it should be. I am reasonably satisfied with the result. Had there been more time, I would have expanded on its numerous themes, elaborated them with more historical detail, and reviewed the thought of a wider range of scientists and philosophers.

It might well be said that we are still too close to the period covered in this study and that an more adequate perspective will be available after the lapse of a few decades. However, my intention has not been to write a definitive account, but to outline and illustrate a method of criticism, a method both essential and so far largely unrecognised. The need for a critical assessment of 20th-century science, with its holdovers from past centuries, its wrong turnings, and its stimulating new insights and initiatives, is urgent if there is to be any hope of mitigating the effects of the global disasters that now loom before us, and ultimately of placing global culture on a less violent and more sustainable track. If this book can spur others on and provide some guidance in their work, my effort will have been worthwhile.

Several people helped me in various ways with this book. My son Kirti continued to provide material and moral support as with all my previous books. My friend Rajeev Tandan made several useful comments and suggestions on technical matters. Purnima Mehta carefully edited the manuscript. My son Hari also gave a number of helpful suggestions. I wish to thank them all. I am also grateful to my publishers Permanent Green for the fine job they have done in bringing out the book.

M. G. Jackson

1
Assumptions

A clear and comprehensive definition of the term 'assumption' is essential in developing this critique of science. The following definition was given in the Preface :

> An 'assumption' is an attempt to explain why a entity or event appears as it does and not otherwise, or indeed appears at all. It has not been, and cannot be, verified by recourse to the concrete experience of those entities or events. It seems likely, but can never be certain.

This must now be elaborated. Further, we must elaborate the term 'worldview' as a set of assumptions deployed concurrently in an attempt to understand our experience of the world. Both these tasks will be taken up in this chapter.

The term 'notion' is defined (in the Concise Oxford English Dictionary, Tenth Revised Edition, 1999) as 'a vague awareness or understanding of something.' In the context of this book I expand this definition by saying that this 'something' is common to the people of all cultures and cultural eras of which we have any knowledge. The most general of these appear to be the following.

- actual entities
- the observer
- time
- space
- causation
- life
- coming to know

These notions will be termed 'formative elements of experiencing'. They enter into and shape every experience. A. E. Taylor, in summing up his commentary on Plato's *Timaeus* has this to say about them.

> In the real world there is always, over and above 'law', a factor of the 'simply given' or 'brute fact', not accounted for and to be accepted simply as given. It is the business of science never to acquiesce in the merely given, to seek to 'explain' it as the consequence, in virtue of rational law, of some simper initial 'given'. But, however far science may carry this procedure, it is always forced to retain some element of brute fact, the merely given, in its account of things. It is the presence in nature of this element of the given, this surd or irrational as it has sometimes been called, which *Timaeus* appears to be personifying in his language about Necessity.
>
> (Taylor, 1927, p. 455)

A notion is expressed in a very general way. Examples of such notions are 'the final actual entities that together constitute the world', 'all events have a logical reason for their occurrence', 'events occur in a logical order, one after another', and 'there is an observer of events'. In any particular culture and cultural era, these are elaborated to give working assumptions. For example, in the history of scientific thought three different assumptions have been developed and deployed for the notion of actual entities that constitute the world. These are:

1. the material atoms of the Greek atomists and modern science, ever-existent and distinguished by unique individual attributes;
2. amorphous substance individuated by the imposition of abstract forms (Aristotle); and
3. episodes of experiencing of A. N. Whitehead.

Each of these is appropriate in the context of the entire set of assumptions, or worldview, of which it is a part. In other words, these assumptions 'make sense', seem natural, inevitable, in its given setting.

The notion of 'actual entities' is composed of four sub-entities. These are physical, thought, emotion and feeling entities. They are all equally actual in terms of our experiences of them. None of them can be seen as derivative of any of the others.[3] Each of them requires two further notions for its explication. These were identified by Aristotle as 'substance' and 'form'. None of the four types of actual entities can be thought of except in terms of these two subsidiary notions. Neither can be experienced without the other. Applying this concept to physical entities, 'What becomes is matter, and, what it becomes is form' (W. T. Stace, quoted by Masih, 1994, p. 95). 'Substance' is that of which an entity is made, but it is imperceptible in the absence of form, while 'form' is that by which we recognise the entity as a distinct, and distinctive, entity. The substance of any entity, whether physical, thought, emotion or feeling, is the parts of which it is composed, and its form is the pattern of the interactions among them.

A critique of the assumptions of any particular worldview can only be in terms of their effectiveness in helping us to understand the phenomena we experience. They are never right or wrong, neither more nor less right, than any other assumptions. If they work in practice, we go with them; if not, then we discard them and formulate alternatives – or, at least we should do so. When we fail to replace them, the science we practise becomes dysfunctional and misleading.

---

[3] There is a tradition in Western science to consider thoughts, emotions and feelings as derivatives of physical entities, that is, of being caused by the motions of physical entities. This has resulted in the necessity of creating the concept of mind which, quite implausibly, 'translates' these movements of physical entities into thoughts, emotions and feelings.

To be effective assumptions must be logical and believable. The term 'logical' means that it must not contradict itself. An example of such a self-contradicting assumption in the worldview of modern science is the concept of the person as an observer of phenomena. It is said that a person is a physical entity, a complex system of physical entities, and at the same time that it observes physical entities, including itself. This begs the questions: how can one physical entity observe another? The ability of a physical entity to observe anything is not specified as a primary attribute of physical entities, so what is this ability to observe, where does it come from? These questions do not seem to have any answers consistent with the worldview of Newtonian science. An example of an unbelievable assumption is the concept of gravitational force.[4] (The concept of gravitational force is a deduction from the assumption about the nature of causality.)

To be effective an assumption must also cohere with the other assumptions concurrently assumed to ensure that a worldview in which it features serves the purpose for which it is created, namely to help us organise our personal and collective lives, effectively.

> 'Coherence' ...means that the fundamental ideas ...presuppose each other so that in isolation they are meaningless. This requirement does not mean that they are definable in terms of each other; it means that what is indefinable in one such notion cannot be abstracted from its relevance to the other notions.
>
> (Whitehead, 1929, p. 3)

If this requirement is not met our thinking about and dealing with phenomena is likely to be confused and lead to problematic outcomes in practice.

---

[4] Refer to the quotation of Newton on page 6-7.

As an example of the way individual assumptions presuppose each other for their definitions, consider the pair 'actual entities' and 'the observer'. Neither has any meaning without the other. Another example is the pair 'physical entities' and 'space'. There must be an interval unoccupied by any physical entity between two physical entities for us to know that there are two entities and not one. Also, we know that there is a physical entity only because it occupies an enclosed volume. In the absence of any physical entities we can have no conception of space; about empty space we cannot say anything. Time and events are similarly inter-dependent assumptions. Events are composed of a series of specific interactions among entities arranged in a logical sequence. The arranging is the work of time. On the other hand we depend upon the occurrence of events one after another (and not all at once) for our conception of time.

A concept of a worldview cannot however be grasped solely in terms of the sum total of a number of inter-dependencies between pairs of its constituent concepts. It must be thought of as a process in which all its constituent assumptions interact simultaneously. This is the final definition of coherence.

This simultaneous interaction of assumptions derived from the notions listed above can be understood as a complex thought entity with a distinctive form. That form is not a static pattern. It is flexible and dynamic. It can absorb and integrate new experiences, that is, new phenomena from daily experience or scientific research, and still maintain the essential features of its form - within limits. Beyond those limits it collapses into an incoherent jumble of non-functional elements (assumptions).

If a worldview is coherent it will better withstand the buffeting it continually receives from the newly appearing phenomena that need to be understood. A coherent worldview is more resilient

than an incoherent one. The latter is more likely to disintegrate under pressure, leaving those who operate in terms of it in confusion and despair. This is the lesson the 20th century has taught us. Our task in this century is to fashion an alternative worldview and it behoves us to strive for coherence while doing it. Some people working in the 20th century itself have suggested promising alternative assumptions, but paid scant attention to the need for a complete and coherent system.

The system we have inherited from the 17th-century is highly incoherent. The assumptions about actual entities, time, space and the subject of experiencing are entirely stand-alone concepts, none of them dependent on any of the others in any way for its definition. This is clear from Newton's Scholium to his eight definitions at the beginning of his *Principia*.

> Hitherto I have laid down the definitions of such words as are less known, and explained the sense in which I would have them to be understood in the following discourse. I do not define time, space, place and motion, as being well known to all. Only I must observe, that the vulgar conceive those quantities under no other notions but from the relation they bear to sensible entities. And thence arise certain prejudices for the removing of which, it will be convenient to distinguish them into absolute and relative, true and apparent, mathematical and common.
>
> > I. Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without regard to anything external, and by another name is called duration: relative, apparent, and common time, is some sensible and external (whether accurate or unequable)

> measure of duration by the means of motion, which is commonly used instead of true time; such as an hour, a day, a month, a year.
>
> II. Absolute space, in its own nature, and without regard to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces; which our senses determine by its position to bodies, and which is vulgarly taken for immovable space; ...absolute and relative space are the same in figure and magnitude; but they do not remain always numerically the same.
>
> (Hawking, 2002, p. 737-8)

The key phrase here in defining absolute time and space is 'without regard to anything external.' A.N Whitehead termed them 'receptacles' and explained that '...bits of space and time were conceived as being as actual as everything else, and as being "occupied" by other actualities which were bits of matter' (Whitehead, 1929, p. 70).

The definitions of actual entities and of the observer that Newton implicitly assumed were already parts of scientific thought of the time. In their most abstract formulation they are Descartes 'matter' and 'mind', which he (Descartes) insisted were completely independent of each other.

2
Newton's shadow

In 1900 at a meeting of the British Association for the Advancement of Science, Lord Kelvin reportedly said: 'There is nothing new to be discovered in physics now. All that remains is more and more precise measurement' (Reported by Isaacson, 2007, p. 90). [5] His confidence implies that scientists at that time possessed a complete and adequate set of assumptions that together explained of why entities are as they are observed to be and do what they are observed to do. The most important of these assumptions were of small, irreducible physical entities possessing intrinsic qualities, 'laws of nature' described in precise mathematical (that is, algebraic) terms, time and space as receptacles for entities and events, and human beings as detached observers of the world. These are the assumptions on the basis of which Newton wrote his *Principia*. Though some of them were only implied by him, they were active determinants of his system nonetheless.

Today, a century later, Lord Kelvin's statement may seem to have been rash, but it must be remembered that scientists since Newton's time believed that ultimately a complete, final, true picture of the universe was possible, indeed inevitable, using his scientific scheme. No doubt that scheme would be extended and refined in various ways, and our pool of knowledge would increase as a result. Most scientists in the 20th century still seem to believe

[5] Lord Kelvin, the British mathematical physicist and engineer, contributed to the formulation of the first and second laws of thermodynamics, and to the unification of the diverse theories in physics that existed in the second half of the 19th century. He determined the value of absolute zero temperature. (The SI unit of measuring temperature has been named after him.)

that it is possible, with diligence, to discover 'the truth' and arrive at a complete and final explanation for everything. The Hellenic scientists of Alexandria, and the Aristotelian scientists of medieval Europe felt the same way about their science.

That said, it must be recognised that science is, as I maintained in the previous chapter, based on assumptions, and that these assumptions are fallible human constructs subject to the necessity of revision at any time. Had Lord Kelvin been able to recognise his assumptions, articulate them and then critique them, he would not have been so optimistic.

Looking back from the present, we can see that by beginning of the 20th century Newtonian science was already compromised at the level of its underlying assumptions. For example, the existence of 'the ether', so essential to legitimising the concept of gravitational force, had been abandoned as the result of the experiment of Michelson and Morley in 1887. A new phenomenon, electro-magnetism, had been discovered by Michael Faraday. James Clerk Maxwell then described this phenomenon mathematically, but found his equations incompatible with the equations describing the movements of the discrete physical entities of Newtonian mechanics. The concept of 'chance', which contradicts the assumption of absolute mechanical determinism of Newtonian science, was postulated by Charles Darwin in his 1859 book *The Origin of Species* and was widely accepted by scientists by the end of the century. Sigmund Freud had taken the first tentative steps in articulating his concept of the unconscious mind, thus challenging the sanctioned scientific view that all irrational behaviour is the result of bodily dysfunction.

In addition to these, cracks in the official protocol had begun to appear. Darwin flagrantly and knowingly disregarded the official protocol by suggesting, on the basis of his own experience, that intuition is an indispensible input to the process of formulating

descriptions of phenomena (see Stone, 1982, p. 556 and p. 626). Henri Poincare (Fuchian functions), Jacques Hadamard (number theory, complex function theory, differential geometry, partial differential equations), Andre Marie Ampere (electromagnetism) and Karl Friedrich Gauss (many fields of mathematics) have all reported how intuitions were crucial to their discoveries (Koestler, 1964, pp. 116-18). The chemist August Kekule (the ring structure of the benzene molecule), Dmitri Mendeleev (the periodic table of chemical elements), and Niels Bohr (the planetary model of the atom) all formulated their theories on the basis of dreams they had had (Ibid., p. 118). All these scientists ignored Newton's injunction that scientists should confine themselves to induction from observations to arrive at descriptions of phenomena.[6]

In the 20th century the work of scientists in many fields of endeavour completely belied Lord Kelvin's expectations. In the first decades of the 20th century atoms and subatomic particles became increasingly elusive, surviving tenuously only as terms in algebraic equations.[7] Biologists, who had earlier acquiesced in the mechanistic model of the physical sciences, began to think afresh about phenomena in their domain. In the latter half of the century, the systems concept was formulated which shifts attention from the parts of entities to the whole. These wholes are dynamic, self-organising systems which can only be adequately described in terms of abstract, two-dimensional (time and space) non-mathematical, conceptual (thought) entities. The implication of this theory, still not realised by all biologists up to the end of the century, and by physicists not at all, is that all systems are

[6] For a description of Newton's positivism (see Burtt, 1932, pp. 209-220).

[7] Bertrand Russell in his *History of Western Philosophy* published in 1946 wrote that a physical entity is 'what satisfies the equations of physics; there may be nothing satisfying these equations; in that case either physics, or the concept of 'matter', is a mistake (Russell, 1946, p. 598).

organisms, whether they are labelled in conventional Newtonian scientific terms as 'dead, or 'alive'. In the following chapters we will go into these broad developments in some detail in order to get at the assumptions underlying them.

Surveying the century as a whole we have identified three main lines of scientific thought and work. The first was that of theoretical physicists who claimed to have broken decisively with Newtonian assumptions and created an altogether new science. Our critique of their work in Chapter 4 reveals, however, that this claim is exaggerated, to say the least. The second line was that of the biological scientists who similarly claimed to have created a new science, but, as we shall see in Chapter 5, with rather more justification than in the case of the physicists. The work of the physicists, from our perspective in this century, seems to be leading to a dead end, whereas that of the biologists appears to have the potential to truly transform science as it was conceived at the beginning of the 20th century. My specific reasons for these broad conclusions will become evident as we proceed.

The third line of thought and work is that of the mainstream scientists. They pursue a 'business as usual' agenda, that is, they continue to think broadly in terms of Newtonian assumptions as they were formulated at the beginning of the last century. When confronted with the negative feedback from the deployment of technologies and organisational models created by this science, they had no real answers. It appears that the challenge of abandoning existing assumptions and formulating others in their place was just too daunting, too unsettling, to be faced. This reaction is similar to that of the Aristotelian schoolmen of the medieval European Universities. In Chapter 3 we will examine mainstream 20th-century science in order to expose and describe the assumptions of Newtonian science; these descriptions will form

our reference point for deciding which assumptions, if any, changed in the course of the century, and in what ways.

Once Aristotle's writings had been translated into Latin in the 12th century, his thinking came to dominate Western science over the next five centuries. For the last two centuries of that period, however, it became an obstacle, preventing medieval European society from adapting to changing world conditions. Metaphorically speaking, we might say that scientists were working in his shadow, dimming their understanding of the nature of the challenge before them; they were groping in semi-darkness, so to speak. In the 17th century, Newton's thinking finally, decisively, replaced Aristotle's. But by the beginning of the 20th century that thinking became manifestly inadequate; scientists working in that century could be said to be groping in Newton's shadow. It may be said that mainstream scientists worked completely in that shadow, the 'new' scientists knew they had to emerge from it, but were largely unsuccessful in doing so, emerging only fitfully, while a few biologists and systems scientists of the last half of the century emerged more or less completely to find that they had a vast and challenging new scientific agenda before them. Our examination of this latter development in Chapter 5 will not reveal any one decisive contribution, but rather the cumulative contribution of many individuals scientists.

1
Mainstream science

In this chapter the most important assumptions of mainstream scientists in the 20th century answering to the notions listed in Chapter 1 will be identified and critically examined.

3.1 Actual entities

The assumption that physical entities are the only type of actual entity dominated 17th-century, Newtonian science, and continued to be a feature of mainstream science throughout the 20th century. It was formulated in detail as follows.

1. Our experiences are of physical entities. These are the only entities that actually exist.
2. Each of these actual entities has a definite form that can be described in terms of its mass, its volume, its shape and its motion. These are the so-called 'primary attributes'.
3. A material entity can be analysed into two or more smaller entities. These, in turn, can be analysed into yet smaller entities, and this successive subdivision of entities can be continued as far as analytical and observational techniques permit. However, it is assumed in advance that there is a finite limit beyond which subdivision ceases; that is, there is a 'final' entity which has no parts. It is ever-existing, never changing. Mainstream science attempts to discover this ultimate entity.
4. Every physical actual entity is manifestly a part of a larger entity, and that larger entity too is a part of a still larger entity. But there is a finite limit to this series of larger

> and larger entities; in other words, there is an ultimate entity which is not a part of anything larger. The discovery of this largest entity is also a legitimate goal of scientific research.

The first assumption, that the only actual entities in the world are physical entities, ignores the fact that there are other types of actual entities as well. A thought, an emotion and a feeling are also actual entities, an entity being anything that is experienced by an observer. These three types of actual entities are clearly of a different type than physical ones. Compared to physical entities which are considered to be enduring, their duration is brief and intermittent; they come and they go. They are experienced as being 'in here' rather than 'out there'. It is unclear where they come from. This first assumption thus gives rise to a host of questions for which there are no answers. The science of human behaviour has been severely stunted and warped as a result of adhering to the first assumption, leading to needless confusion and suffering. These questions will pop up repeatedly in the sections that follow in this chapter and in the remaining chapters.

Concerning the second assumption, A. N. Whitehead has pointed out that what are assumed to be primary attributes of physical entities are not attributes of these entities at all. Rather, they are descriptions of the relations among entities in the context of the larger entity of which they are parts, or of the system of entities in which they participate (Whitehead, 1929, p. 309). In the absence of other entities they would have no attributes at all. In isolation an entity has no form. An observer would not be able to point and say 'there is an entity'. In isolation an entity cannot be said to exist. Whitehead has termed this spatialisation of a set of relationships the 'fallacy of misplaced concreteness' (Whitehead, 1925, p. 51).

Mainstream science rested content with this fallacy for the past three centuries. In terms of it:

> The history of thought in the eighteenth and nineteenth centuries is governed by the fact that the world had got hold of a general idea which it could neither live with nor live without.
>
> (Whitehead, 1925, p. 50)

They could not live without it because if they questioned it, the whole edifice of their science would collapse. They began to realise in the 20th century that they could not live with it because it no longer helped them understand the nature of the phenomena newly discovered, or for that matter, the anomalies in their worldview that it had created.

Whitehead further points out that 'primary attributes' are not only relationships among the individuals comprising the system, but also within each of the individuals (Whitehead, 1929, p. 309). As we have just said, the substance of an entity is reduced to a mere dimensionless point, a locus of diverging and converging lines of relationship, to use a spatial metaphor. Nonetheless, it remains an entity; if it ceased to be an entity there would be no system of relationships. The individual relata (that is, entities that are related) have no innate, unique forms, but do have a shared form – the entire system of relationships of which they are parts. Each is the whole, only viewed from a different relative position within the whole.

The blind spot of mainstream scientists to the importance of relationships among physical entities caused them to convert relationships into entities. This process is formally termed 'reification'. It was of the utmost importance in shaping Newtonian science and in the attempt of mainstream 20th century scientists in preserving that science intact. This is, therefore, a topic that needs our attention.

Newtonian science features three sets of relationships that were reified giving rise to the concepts of gravitational force,

heat and light. These concepts are not assumptions in the sense in which this term is defined in this book; rather, they are deductions made from such assumptions.

Newton's concept of gravitational force became the prototype for all the subsequent types of forces that have been formulated by physicists. Gravitational force is said to be a tendency of a physical entity to draw other entities to itself. Its strength is proportional to its mass and to its distance from the entity which it attracts. This force is not perceptible; that is, it is not a physical entity. Against his better judgement (see quotation on pages 6 and 7), Newton said it is a definite, if subtle, entity in its own right, something that acts across empty space. This concept gained currency and has persisted down to the present in mainstream science.

The faulty logic of Newton's concept of force was not questioned at that time, and has not been questioned since by mainstream scientists. It is dependent for its legitimacy on the assumption that the mass of a physical entity is a primary attribute of that entity. Mass, however, is not an attribute of the entity, but an acknowledgement of the entity's relationships to the other parts of the system in which it participates. The relationship between any two physical entities is thus a derivative of the relationship each bears to the whole of which they are both parts.

The argument for the existence of force as an actual, physical entity may also be framed in terms of causation. Entity A causes entity B to move towards it. This however, only appears to be the case when the pair of entities A and B is seen in isolation from the system of which both are parts. When seen in the context of the whole, the parts move in relation to each other as a result of their participation in the whole.

The tendency to use a metaphor of a physical entity to explain a relationship between pairs of physical entities is common in mainstream science. However, when we forget that these entities are metaphors we create problems for ourselves. These problems are simply ignored; Newton avoided explaining what gravitational force is. As a result it strikes a discordant note in the symphony of the materialist worldview.

> Newton's concept of 'gravitational force' has always lain as an indigestible lump in the stomach of science; and Einstein's surgical operation, though easing the symptoms, has brought no real remedy.
>
> (Koestler, 1959, p. 344)

The other examples of the use of physical metaphors to represent relationships between physical entities in Newtonian science are heat, and light. Heat is depicted as an imperceptible something that flows from one physical entity to another, as for example when a beaker of hot water is placed in a larger beaker of cold water – the former cools and the latter warms up. The glass wall of the beaker of hot water is not a barrier to the 'flow' of heat. The amount of heat transferred is measured indirectly by comparing a thermometer reading of the water in the small beaker before placing it in the large beaker and then again when the reading for the two beakers has become the same. This quantification of the process strengthens the impression that what flows from one beaker to the other is a definite physical 'something'. In textbooks of physics it is said that heat is one form of energy, all of which is also measured indirectly, and all pictured as physical entities, fluid or particulate.

The concept of light is the third example in Newtonian science of a relationship being described in terms of a physical metaphor. Suppose I perform the following experiment. I take two visible

physical entities into an absolutely dark room. One of them (A) remains visible to me; the other one (B) becomes invisible. Further, an entity (C) which I had earlier placed in the room and which became invisible to me when I placed it there, becomes visible to me again when I bring A and B into the room. Finally, if I remove A subsequently, B and C again become invisible to me. The problem for the scientist is to explain this sequence of experiences. The mainstream scientist says that A emits a subtle something called light which travels from the lighted entity (A) to the invisible entities B and C which then become visible to me. B and C were visible outside the room because they were in the presence of that other lighted entity, the sun. This subtle something was pictured by Newton as small material entities. These travel from a visible entity like A to an otherwise invisible entity like B or C, making it visible. The velocity of these light entities is quantified as the time taken for them to travel from one entity to another.[9]

In the late 19th century the concept of fields was created in an attempt to explain the newly-discovered phenomenon electro-magnetism. In the 20th century it was used to explain many other phenomena in the subatomic realm as well. Fields are said to be generated by individual subatomic particles. These fields reach out to every other particle in the whole of which the particle is a part. The strength of this influence diminishes with distance. It is visualised as a wave pattern on the analogy of water waves, but in the absence of any material substance in the intervening space, waves are all form and no substance; they are waves of – nothing. This is a logical impossibility. Fields are thus, like force, heat and light, reifications of a system of relationships among the parts of a whole.[10]

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[9] A rival theory of light as waves of something flowing from one entity to another was also proposed in the 17th century by Robert Hooke.

[10] This did not occur to me until I read Edward Goldsmith's *The Way: An Ecological Worldview* (Goldsmith, 1998, p. 273).

All these reifications are convenient, indeed logically necessary, given the assumptions of Newtonian science. They are, however, further examples of Whitehead's 'fallacy of misplaced concreteness' and hence misleading. The challenge of learning how to deal with relationships directly, as relationships, must be faced.

All these reifications are convenient, and indeed are logically necessary given the assumptions of Newtonian science. In the long run, however, they are misleading. They are all indigestible lumps in the stomach of that science.

The third and fourth assumptions in the list at the beginning of this section must be questioned because logically they are untenable. We can be certain, given the alternative concept of what mainstream scientists term 'primary attributes' outlined a moment ago, that the largest entity we can discover would be part of a still larger entity, because if it were not it would not have a form, its form being the pattern of relationships among all the parts of that larger entity. Without form, we would not experience it. At the other end of the scale, if we consider the smallest entity we can discover, it must be conceded that it is substantial only because it has parts. Thus there are infinite regresses at the upper and lower ends of the size scale of physical entities.

3.2 The observer

An experience is the outcome of the interaction of a subject and an entity, an observer and an entity which is observed. Both are formative elements of experiencing, notions which are impossible to define except in relation to each other. However, this does not mean that either can be seen as a derivative of the other, but rather that they are mutually dependent upon each other for their definitions. Nor can either of these be derived from any of the other formative elements of experiencing, though they are dependent upon each of the others for their definitions, just as all the others are dependent on them for their definitions.

A fully coherent worldview made up of assumptions about each of these seven formative elements of thought will exhibit these mutual dependencies.

The most general formulation of the notion of the observer is that of the 'I'. It is present in every experience, as is attested to by the way experiences are described: 'I saw', 'I felt', 'I thought', 'I was frightened'. This is not just a matter of grammar. Trying to avoid using 'I' by saying, 'there was seeing', etc., only raises another question: who says 'there was seeing', etc. who or what sees simply cannot be explained away. This is the meaning of a formative element of experiencing; it can neither be explained as a derivative of something else, nor explained away.

The more proximate formulation of the concept of the observer is that it is a person, that is, an organism with the form *Homo sapiens*, in whom the 'I' seems to be lodged. It is not the person as an organism because it is utterly, finally, impersonal. It does not change in any way throughout the life of the organism. It clearly does not belong to the person, though the person says 'I saw'. What he or she means is 'the I in me saw'.

In the context of the 17th-century worldview in which the assumption of physical entities as the only actual entities it was found necessary to postulate the concept of 'mind' to account for thoughts, emotions and feelings. These were termed 'secondary attributes' of physical entities. By this it was meant that the feelings (or sensations) of smell, colour and taste are produced by the mind as a further experience to that of a physical entity. They are not attributes of physical entities but are caused by experiences of them. Similarly, thoughts and emotions are further experiences, created by the mind, as a result of experiencing physical objects.

In 20th-century mainstream science this was increasingly discarded in favour of the concept that functions of this mind, including that of being an observer, can be performed by the

brain.

The logical flaw in this concept is obvious. If observation is the result of brain functioning, then the observer has been defined in terms of material entities and the relative movements of their parts. This amounts to defining one formative element of experiencing as a derivative of another. This is inadmissible if our objective is to create a coherent worldview.

If the mainstream scientist were to acknowledge this error, he or she would realise that they have returned to square one and are again faced with the question: how are we to frame a viable assumption about the observer? The first step, I suggest, is to accept that there is an observer in every experience. It participates in all the activities of the person. Next, accept that it is utterly impersonal. This means that it is the same, unchanging across all the activities of the person in which it participates. It is the same in youth, maturity and old age. Third, we do not seek to define it, and when we cannot, try to explain it away. These are recommended rules for dealing with any of the formative elements of experiencing.

3.3 Time

The 'receptacle' assumption of time formulated by Newton has been referred to in Chapter 1. The assumption among scientists and non-scientists alike before his time was the 'vulgar' (or common sense) view that our sense of time is derived from the observation that events occur in a sequence in which each event is a logical continuation of the one that preceded it. The wording of Newton's definition makes it clear that he chose to ignore the concept prevailing at the time because he saw it as a hindrance to the development of his project of describing and explaining the movements of celestial bodies. Nevertheless, his assumption became the shared assumption among mainstream Newtonian scientists until the end of the 20th century. This story has two morals if we

care to acknowledge them. The first is that, when engaged in creating an alternative worldview, which is what Newton did, it is rash for scientists to disregard traditional assumptions out of hand just because they are traditional. The second is that new assumptions should not be formulated in isolation from the other assumptions with which they will have to function in the new worldview. To do so is bound to create incoherence.

It is important to realise that our sense of time derives from multiple experiences, a series of experiences of logically related entities or events viewed as a whole. The term 'logical' used here means that each entity or event that appears in a sequence can be seen as the logical continuation of the one immediately preceding it, and is itself the logical precursor of the one following it. Causation and time are immediately and most obviously dependent upon one another for their definitions.

A sense of time is equally obtained from the observation of a series of thoughts, emotions and feelings in the same way as in the case of physical entities.

3.4 Space

The common-sense view of space is that it is what makes physical entities stand out as distinct, separate entities within a whole. Newton also replaced this concept of space with his concept of a receptacle. The same criticism of the receptacle concept as was made in the case of time applies here in the case of space.

Our sense of space is obtained from a single experience of a physical entity in the context of the whole of which it is a part. The parts are experienced as distinct entities, that is, they have boundaries and immediately outside these boundaries there are no other entities. There are finite distances between each part and each of the other parts of the whole. Each part occupies a unique position in relation to the other parts within the whole.

Space and physical entities are immediately dependent upon one another for their definitions.

Space, as a formative element of experiencing, operates only within a given experience whereas time operates only across a sequence of experiences in a series of logically-related individual experiences.

This concept of space applies also to thought, emotion and feeling entities inasmuch as they are always experienced in relation to my body, that is, the body of the experiencer concurrently experienced. When we experience thoughts we do so in terms of images of physical entities; that is, physical entities are employed symbolically. When I have a 'heart-stopping' experience, I feel it in the region of the solar plexus, and a toothache is my toothache, that is, a tooth in my mouth is aching.

3.5 Causation

The phenomena we experience are marked by a noticeable degree of regularity, persistence and recurrence. We attempt to account for these features in terms of some specific formulation of the notion of causation. In the history of Western scientific thought two distinct assumptions about the nature of causation have featured. The first is the law of imposition. In this concept of law actual entities are related only externally.

> 'The character of each of these ultimate things is thus conceived as its own private qualification. Such an existent is understandable in complete disconnection from any other existent: ...it requires nothing but itself to exist. But ...there is imposed on each such existent the necessity of entering into relationships with the other ultimate constituents of nature. These imposed behaviour patterns are the Laws of Nature. But you cannot discover the natures of the relata by any study

> of the Laws of their relations. Nor, conversely, can you discover the laws by inspection of the natures.'
>
> (Whitehead, 1933, p. 117).

The second assumption is that order is the law as immanent in actual entities. In other words, order is achieved by each of the many parts of an entity or process working in accordance with its own nature, which is the nature of the whole.

> ...the order of nature expresses the characters of the ...things which jointly compose the existences to be found in nature. When we understand the essence of these things, we thereby know their mutual relations to each other ...[the doctrine of causation as immanent] presupposes the essential interdependence of things.
>
> (Ibid., p.116)

The first of these assumptions about the nature of causation is the one adopted by mainstream scientists. The actual entities with which they are concerned are physical entities. These are in constant motion relative to one another.[11]

The movement of a physical entity, say A, with a measured mass and moving in a defined direction at a measured velocity, and the movement of entity B, also with a measured mass and moving in a defined direction at a measured velocity can be related one to the other by a single algebraic equation. This is what Newton did when he formulated his three laws of motion. These equations were developed in the context of planetary motion, but quickly came to be used in all areas of scientific enquiry.

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[11] This general statement about the nature of causation covers all types of actual entities – physical, thought, emotional and feeling – but for the purposes of this chapter we are concerned with its application only to physical entities since these are the only type of entities recognised by these scientists.

The problem with these laws of Newtonian mechanics is that they have never been unequivocally validated in practice. In principle, they cannot be – because the concept of causation in terms of which they are an expression and justification is faulty.

A neat and absolutely repeatable connexion between two variables cannot be demonstrated because for any event, B say, there is more than one cause, or, in other words, that A is only one of the causes of B. These other causes may be evident, and with great attention of experimental procedure, some of them may be neutralised.[12] Those that cannot effectively be neutralised are simply ignored. Where ignoring them is not practically possible (which it is not in events featuring entities which are parts of complex subsuming entities), an elaborate statistical procedure is used to estimate the likelihood that the observed event is in fact the result of what is thought to be the causal event. Indications of failure to identify the presumed single causal event are that B does not appear at all after A, that it appears but not exactly as B but as B_1, or that B is unexpectedly accompanied by C, D or E. These occurrences indicate that causes are operating that are not recognised, or that recognised causes other than the most obvious one, cannot safely be ignored, or can be ignored only with a high risk of drawing the wrong conclusion.

The only way to deal effectively with this problem is to abandon the assumption of causation as imposed on entities and adopt the alternative assumption of causation as immanent in entities. With this assumption entities are seen as parts of the larger entities which subsume them, and what are termed 'primary attributes' of entities are seen as systems of relations among all the parts of

[12] This accounts for the experimentation protocol devised by Galileo of attempting to create 'ideal conditions' in which to conduct experiments. Needless to say it is impossible to achieve these in practice; this is indicated by the fact that repeated observations never give identical results.

these larger entities. When this is done, an entity is seen to behave as it does because of where it is – embedded in a particular system. When Whitehead, in his definition of law as immanent quoted earlier in this section, refers to the 'essence' of an entity, he is referring to the pattern of the system of which it is a part as it's essential nature. Its behaviour can only be seen and understood with reference to that essential nature.

When this alternative assumption about causation is adopted it becomes obvious that an alternative method of describing the movements of physical entities is also needed. The algebraic method of describing the relationships between selected pairs of parts of an entity, for example the relationship between the earth and its moon, must be abandoned. The reason for this must be clearly understood.

Using the algebraic method of describing relationships only two entities can be dealt with at a time. Thus the relative movements of A and B entities are described in one equation. Given this equation, the present positions of A and B, and velocities, their relative positions at any future time can be calculated. If the system under study contains more than two parts, it is broken down into pairs for description. Thus a system that has four parts, say A, B, C and D, descriptions can be generated for A-B, A-C, A-D, B-C, B-D and C-D. A single equation describing the simultaneous interactions of all four, A-B-C-D, however, is not possible given the limitations of the mathematical technique used.

The reason for this is that once you have abstracted the parts of a functioning whole and described them individually, you cannot reconstruct the whole by summing up those individual descriptions. A model of the intact solar system created by clubbing together all the separate models of the interactions between the individuals of pairs will be incomplete; it will be lacking that which

makes it a functioning whole. This wholeness is the 'picture' of its functioning held by each of its parts as mentioned in Section 3.1.

The rationale for this foregoing critique of the experimentation protocol of modern science is Aristotle's distinction between 'wholeness' and 'totality' in studying entities. He insisted that the whole is more than the sum of its parts. Bernhard Glaeser, interpreting this concept has written:

> Underlying this principle is the consideration that cross-system inter-relations cannot be extrapolated and interpreted from partial areas; the opposite is true: only when a system's coherence is fully understood can partial areas be classified, hence known.
>
> (Glaeser, 1995, p. 14)

The whole cannot be created by assembling the parts by algebraic or geometric methods. The whole must be 'seen' and not deduced. One glance is sufficient. This amounts to 'seeing' the whole, rather than the parts, a shift from one frame of reference to another. Once this is done, our experimentation protocol will change fundamentally. Our strategic objective will change, and accordingly we will need to employ different tactics.

An intact, functioning system can be modelled, but only as a conceptual map. The map will be of the pattern of the relative movements of the parts of the system at successive time intervals. Such a pattern will be found to be repetitive in the sense that a distinctive set of relationships among the parts will be seen to recur from time to time. In modelling systems of physical entities, the method is to construct a series of static models, snapshots, as it were, of the system and then highlight those that have the same, or at least similar, configurations. I say 'at least similar' because in complex systems composed of many parts, there will

be myriad details in each snapshot and it is not possible for the scientist to note every one of them. However, a few features will stand out and catch his or her attention. When this is done specific events that are features of that future configuration can be expected to occur again. Of course, the trajectory of any part within the whole can also be traced in this series of snapshots.

The form of an entity, that is, its characteristic pattern, is not fixed and invariable, but rather dynamic and flexible. It can be deformed in various ways as a result of pressure Imposed on it, but bounce back once the pressure is removed. The order which is the expression of this form is thus not invariant over time. And if an entity is stressed to the point beyond which it cannot rebound, that entity disintegrates. But the form lives on in other, currently living entities of the same species. Even if no living entity of that species remains in the world, its form remains as an inalienable part of the whole in that the world as it is configured in the present moment. That form is the result of the totality of its successive configurations in the past.

In Section 3.1 we discussed the problem in modern science of mistaking relationships between events for physical entities. The concept of characteristic forms offers an alternative way of dealing with these relationships as relationships. If an entity is understood as a temporal sequence of experiences, then each experience is of a different entity, though all are same in terms of their form. Taking in the entire sequence at a glance, so to speak, we discern its form. One feature of this form is the appearance of A followed later by the appearance of B. A does not cause B, as the modern scientist would say, but simply follows it in accordance with the requirements of the shared form of the whole.

Given that the assumptions of primary attributes, forces and the quantitative mathematical mode of describing actual entities and their behaviour that inform the thinking of modern scientists

are not tenable, the alternative sketched above suggests itself. The descriptions resulting from using this method can guide us (scientists and everyone else) when we seek to intervene in natural and human systems with our technological innovations and organisational models without distorting or destroying them. The rule here would be that to be wholesome and sustainable such interventions must not distort or destroy the characteristic configurations of these systems. If the interventions amount to the addition or deletion of a part, or the modification of a part, they are likely to distort or even destroy the system. This may not be seen immediately; when it is eventually seen, it may be too late to salvage the system. Interventions devised from descriptions of systems created by following the protocol of modern science have become notorious for distorting and destroying existing systems.

3.6 Life

To the mainstream, 20th-century scientist the concept of life is problematic because it is impossible to say what it is in itself, and yet it seems to be impossible to explain the behaviour of physical entities, whether large or small without it. If an adequate system of assumptions, or worldview, is to be created, the concept of life cannot be ignored. But this is precisely what the scientists of the 17th century did when they created a new worldview. Thus they created the problem confronting the inheritors of their system. This is an example of the dysfunction of an incoherent worldview. In Chapter 1, life was included in the list of formative elements of experiencing. These elements cannot be ignored or explained away; they can only be accepted.

To accept the notion of life as a formative element of experiencing would contradict the assumption of mainstream scientists that physical entities are insentient lumps of matter

pushed and pulled about by forces. The discoveries made in the 20th century suggest, as we have seen in the preceding sections of this chapter, that of the assumption about the nature of actual existents is faulty. But these scientists were unwilling, or unable to abandon their assumption that material particles are insentient. Instead they said that life is an 'emergent property' of complex physical entities. This term refers to the '...way complex systems and patterns arise out of a multiplicity of relatively simple interactions.... The emergent is unlike the components insofar as these are incommensurable, and it cannot be reduced to the sum of their differences' (Wikipedia article *Emergence*, consulted on 15/1/2014). There are two versions of this concept, 'weak emergence' and 'strong emergence'. 'Weak emergence is a type of emergence in which the emergent property is amenable to computer simulation. This is opposed to the older notion of strong emergence, in which the emergent property cannot be simulated by a computer' (Bedau, 1977) (Ibid.). Further, 'Strong emergence describes the direct causal action of a high-level system upon its components; qualities produced this way are irreducible to the system's constituent parts (Laughlin, 2005). The whole is greater than the sum of its parts. It follows that no simulation of the system can exist, for such a simulation would itself constitute a reduction of the system to its constituent parts' (Bedau, 1997) (Ibid.). The concept of strong emergence is considered to be the manifestation of life.

A critique of this concept of life was offered by P. W. Anderson.

> The ability to reduce everything to simple fundamental laws does not imply the ability to start from those laws and reconstruct the universe. The constructionist hypothesis breaks down when confronted with the twin difficulties of scale and complexity. At each level of complexity entirely new

> properties appear. Psychology is not applied biology, nor is biology applied chemistry. We can now see that the whole becomes not merely more, but very different from the sum of its parts.
>
> (Anderson, 1972, quoted in Wikipedia article *Emergence*, consulted on 15/1/2014.)

The similarity of this to what was said in Section 3.5 (Causation) is obvious.

There is still another problem with the concept of life assumed by mainstream scientists in the 20th century. Why are some physical entities living and some not? Why does the mainstream scientist say that an atom and a stone are inanimate, that is, devoid of life, while an oak tree and a cow are animate? Are there any essential differences between these two groups of entities? The entities of both groups are systems of parts and at the same time more than the sum of those parts. They are wholes and it is this wholeness that gives them their form. Both manifest dynamic continuity of form, and define and organise themselves. They are born and they die, though their life spans may differ. This distinction is illogical and, it seems to me, a compromise reluctantly agreed to by scientists who cannot bring themselves to reject completely once and for all the concept of the dead material entity pushed and pulled about by forces.

If we assume that all physical entities are animate, then we have a complete explanation of why they move, and why they move as they do. As animate entities they are perceptive, intelligent, and motile. That is, they perceive the form of the whole of which they are parts, they understand that they must play the part in the whole dictated by the whole, and they move in ways that ensure that they perform their part.

3.7 Coming to know

How does a person come to know anything about the physical entities that surround him or her, or indeed, that there are any entities at all in his or her surroundings. Or, in other words, how does a matter of fact (a physical entity in a world 'out there') give rise to an experience of that entity 'in here'? A satisfactory answer to this question has eluded Western scientists from the earliest times of which we have any record. The answer they give is that this 'coming to know' is the work of the mind. What this mind is and how it works has never been convincingly explained, and therefore, like the concept of force, it has remained an 'undigested lump' in the belly of Western science to the present time.

There are other related problems as well. How does one come to know the thoughts which come to one, and the emotions and feelings? What are these thoughts, emotions and feelings – in themselves? Where do they come from? The sanctioned reply in mainstream modern science is that they come from the mind. This implies that they are 'somethings' - though not physical 'somethings' - and that the mind manufactures them in response to the person's coming to know physical entities 'out there'.

Let us elaborate these brief statements of the problems. First, the answer of how a person comes to know that there are physical entities 'out there'. The answer modern science gives is that units of light (photons) radiate from an entity and travel to the eye of the observer. These light units are generated by the entity itself if it is self-illuminated, or, if not, are reflected by it. In the eye, these units of light impinge on nerves dislodging nerve particles. These dislodged nerve particles travel along the nerve fibres to the brain. There they are transformed into an image of the entity 'out there', and I say 'I see such and such entity in front of me'.

The image is not, however, a physical entity. The original question thus becomes: how is a physical phenomenon, a nerve particle in motion, transformed into a non-physical entity, an experience (of seeing, hearing, tasting or smelling)?

All these problems, and some others we have examined in previous sections of this chapter, arise as a consequence of the faulty assumptions that there is a world 'out there', occupied solely by physical entities in motion. The only possibility of overcoming these awkward problems appears to be abandoning these two assumptions and creating alternatives to replace them. Outlines of possible alternatives have emerged in the course of this chapter. The first is that the world is not an entity 'out there', but a context built up from numerous, momentary experiences into a coherent whole. What actually exists are these experiences; they, and only they, are the 'building blocks' of the world. Second, there is not just one type of entity experienced, but four: physical, thoughts, emotions and feelings. These four are sub-notions of the first notion in the list of formative elements of experiencing (see pp. 14-15).

We are bound to ask further: who is it that comes to know? The answer is the 'I'. The 'I' says 'I have come to know this entity'. The 'I' is thus not only the observer of entities (Section 3.2), but the knower of them as well.

4
'New' Science

When Albert Einstein began his work as a patent examiner in the Swiss Patent Office in 1902, his boss, Friedrich Haler, advised him that in his work of examining patent applications he was

> '...to remain critically vigilant'. Question every premise, challenge conventional wisdom, and never accept the truth of something merely because everyone else views it as obvious. Resist being credulous. 'When you pick up an application,' Haller instructed, 'think that everything the inventor says is wrong.'
>
> (Isaacson, 2007, pp. 78-9)

Einstein followed this advice in his scientific work as well, or rather he appeared to himself and to others to have done so. Actually he completely failed to do this in respect of the assumptions of Newtonian science. The scientists who followed him and built upon his work similarly claimed to have made a clean break from Newtonian science and given us an entirely new 'story' or worldview. In this chapter we will examine these claims critically and try to form an estimate of the extent to which they actually moved out of Newton's shadow in terms of the assumptions embodied in their work. This examination will focus on those specific areas where they claimed to have departed from mainstream assumptions, namely, the nature of physical entities, space, time, causation, and coming to know.

4.1 Actual entities

In Section 3.1 we saw that the assumption of physical entities

with primary attributes is untenable, and further that by assuming it scientists created problems for themselves that they could only solve by creating concepts that became problematic.

Aside from Einstein's claim to have revolutionised the Newtonian concepts of space and time, the most spectacular claims made by early 20th-century physicists were in respect of the primary attributes of physical entities. These latter are the subjects of this section, while the former will be taken up in the next section.

4.1.1 Mass

Newton said that physical entities are 'massy', indicating that he considered them substantial. In formal terms 'massiness' became 'mass', defined as the weight of the entity as determined on the surface of the earth and expressed in terms of an arbitrarily chosen standard unit. He considered the mass of an entity to be the cause of the characteristic behaviour of the entity, in concert with the masses of other entities. That this concept is untenable was not seen by Newton or those who followed him. They failed to see a physical entity as a part of a system, and that logically it is the whole that determines the behaviour of its parts as argued in Section 3.1.

Einstein created a contradiction when he said that photons are massless, while at the same time continuing to think of them as physical entities. When at the same time he did not deny that all other subatomic particles are massy, he added incongruity to illogicality.

The primary attributes jointly describe the form of an entity. At first sight it seems that mass should indicate the entities substance rather than its form. But when we consider that the primary attributes describe relations among the parts of a whole and not the parts individually, mass is a relationship among the parts, a tendency of the parts to move in definite repetitive ways relative

to one another. These movements are a feature of the form of the whole.

4.1.2 Volume

In Newtonian science a physical entity is conceived of as being an enclosed volume of space and as being separated from other physical entities by an interval of empty space. If entities do not have any defining boundaries we cannot say that they exist. 'New' scientists investigating the behaviour of very small physical entities at the atomic and subatomic levels appear to adhere to this way of conceiving them – for the most part, but not always. They have determined the dimensions of atoms and electrons and the distances between them.

'New' scientists sometimes also think of physical entities as fields of influence. However, fields are said to have an origin in space, which is the point from which they emanate and spread in all directions. A field thus does not have clear-cut boundaries; indeed, it does not logically have any boundaries at all, and thus no measurable or even conceivable volume. They end up admitting, if only tacitly, that their volume is as large as the world itself. Is the point of origin dimensionless? Again, in quantum theory these points of origin are termed quanta, a term which implies quantities of something. Can a quantity of anything be contained in a dimensionless point? The answers to these questions are obviously 'no'. This is not surprising given the conclusion reached in Section 3.1 that fields are not physical entities but rather reifications of relationships.

4.1.3 Shape

Mainstream scientists operate on the assumption that the shape of a physical entity is an inherent attribute of the entity itself. When they think in terms of entities as entities in isolation,

their shape is said to result from the way its parts fit together. The way the parts fit together is determined by their shapes. This is reminiscent of the 'atoms' of Democritus and Leucippus with their angles and hooks.

In the Section 3.1 we have seen that this assumption of intrinsic shape is untenable. The forms of the parts of a system do not determine the form of that system but just the reverse. The results of the work of scientists studying the dynamics of systems in the second half of the 20th century imply this, but as far as I know they have not explicitly refuted the concept of intrinsic form. If they could have seen their way to doing this, their claim to have created a new science would be greatly strengthened – provided, of course, that they had also explicitly repudiated the various other Newtonian assumptions they still adhered to, and had described alternative assumptions.

4.1.4 Motion

The research of theoretical physicists in the early decades of the 20th century, like that of their counterparts in the 17th century, was focused on describing and explaining the motions of physical entities. To be more precise, they were concerned with the ways in which entities move. An answer to the question why do entities move was provided early on in the 17th century by Galileo with his assumption that it is their nature to move. This was a primary attribute of all physical entities, termed by him inertia. More precisely, inertia is the tendency of a physical entity to remain as it is, moving if moving, resting if at rest, or, in other words, a tendency to resist change in its initial state. Motion or rest were assumed to be a primary attribute of a physical entity. Twentieth-century theoretical physicists took on this assumption indirectly through their use of the equations of Newtonian science.

Before considering developments in the 20th century, it will be worthwhile reviewing the history of the development of the

concept of inertia in the 17th century. The observation that physical entities move demands an answer to the question: why do they move? In answer to this question two assumptions have figured in the history of Western scientific thought. These were the 'common sense' assumption that entities move as a result of the application of force (push or pull) and the assumption that they move by themselves, the concepts of 'inertia' and 'impetus', respectively. The worldview formulated by Aristotle, which was under attack throughout the 17th century, featured both of these concepts, the former explicitly and the latter only implicitly. Aristotle apparently did not see the contradiction. In formulating his three laws of motion towards the end of the century, Newton also combined both assumptions. Our intention in this section is to critique the assumptions in Newton's laws, but to do so effectively, it will be necessary briefly to review the history of these two assumptions.

In Aristotle's worldview, deriving from observations of terrestrial entities, entities move only when they are pulled or pushed. Otherwise they remain stationary. One particular observation, however, cannot be explained by this assumption. When an entity resting on the earth's surface is lifted up and then released, it returns to the surface by itself. Or, as the Aristotelians said, it strives to return to its 'natural place', which is the surface of the earth. Two terms used in this explanation should be noted. One is 'natural place' and the other is 'striving'. The Aristotelians thought that the universe is an ordered whole in which each entity has a definite place. In the context of a dynamic system this means that it has a definite role or function in the system.[13] Thus, an entity can be seen as striving to remain in its place in the system or to continue to perform its function in the

[13] The adjective 'dynamic' means that the system is characterised by constant change in the relative positions of its parts.

system. 'Striving' implies that a physical entity is sentient, intelligent and mobile. Sentience means that an entity is aware of its surroundings and comes to know its natural place and function in the system in which it finds itself. Intelligence means that it understands that it must remain in its natural place and perform its natural function in the system, and that only if it does so will the system's integrity and general form be maintained. Motile mean that it can move itself as necessary to ensure that it remains in its natural place. These deductions from Aristotle's assumption are relevant to both extra-terrestrial and terrestrial entities. Terrestrial entities are, ultimately, parts of the whole earth system.

A second observation that is difficult to explain, given Aristotle's assumptions, is that an entity such as a stone that I pick up from the ground and throw continues to move in the direction in which I have thrown it even after it leaves my hand. Since the pushing of my hand ceases, it would be expected to drop straight to the ground after it leaves my hand. It does return to the ground eventually, but only in a long, curving trajectory. Aristotle and his followers were forced to introduce the further, qualifying concept of impetus. The effect of the push given to it while in contact with my hand remains for a time after I release it, slowly decreasing in magnitude as the striving of the entity to return to its natural place overcomes it completely. It proved impossible for Aristotelians to explain in any plausible way what this impetus is in terms of simple push and pull. Had they grasped the full implications of their assumption, as suggested here, they might have found a way out of this difficulty. They would have had to realise that the arm that threw the stone is also a system, and that both the stone and the arm are ultimately subsumed in the single larger system – that of the entire earth. Their *ad hoc* modifications of the original push and pull assumption would not have been necessary.

According to Herbert Butterfield this larger conception of the cause of motion was in fact evident in the 17th century in the work of Linnaeus and his followers, and also in that of William Gilbert who

> ... constructed a spherical magnet called a terrella, and its behaviour strengthened his belief that the magnet possesses the very properties of the globe on which we live – namely, attraction, polarity, the tendency to revolve and the habit of 'taking positions in the universe according to the law of the whole' – automatically finding its proper place in relation to the rest of the cosmos. Whatever moves naturally in nature, he said, is impelled by its own force and 'by a consentient compact of other bodies'; there was a correspondence between the movement of one body and another so that they formed a kind of choir; he described the planets as each observing the career of the rest and chiming in with one another's movements.
>
> (Butterfield, 1957, p. 155)

The attributes enumerated by Gilbert are the same as those deduced from Aristotle's formulation. They are the attributes of living beings. Gilbert stopped short of saying that the world as a whole and each of its parts are living beings. Had he done so, his concept of magnetic attraction would have been unnecessary. His terrella would have been seen as a part of a living system or organism, a part of the larger earth organism.

The scientists and philosophers of the 17th century favoured the push and pull notion, but were unable to go along with the Aristotelian explanation of motion because to them the concept of impetus was implausible. The other option, that physical entities are living entities, had come to be seen as unreasoned, a mere

superstition. Galileo made a breakthrough with his concept of inertia. This, he said, was a tendency of entities in motion to remain in motion and of entities at rest to remain at rest. This state of rest can be changed by a force (a push or a pull) acting on the entity from outside itself. Motion can be arrested by a force acting against it. Our critique of this concept of inertia will be twofold, dealing first with the sub-concept that entities move all by themselves, and second with the sub-concept that the magnitude of the inertia of an entity is proportional to its mass. The second sub-concept implies that inertia of an entity is caused by its mass, or weightiness.

Perpetual motion, the concept that insentient physical entities move all by themselves, appears to be a completely arbitrary concept, assumed only because it permitted the formulation of a simple mathematical description. It is simply unbelievable, short of saying physical entities are alive. That possibility had already been dismissed out of hand, and no other possibility seemed to remain.

The second sub-concept that obviously requires our attention is that inertia of an entity is proportional to, and indeed is caused by, its mass. In everyday ordinary contexts this is easy enough to understand. Setting a stalled small car in motions is easier than setting a stalled big truck in motion. While one man can set a stalled small car in motion, it takes at least half a dozen men to set a stalled big truck in motion. The truck weighs more than the car. But the weights of the car and the truck are not attributes of the car and the truck. Their weights are manifestations of their respective relationships to the earth system of which they are parts. Inertia, then is the resistance an entity has to leaving its 'natural place' – or its place and function in the earth system. As such, it cannot be neatly described in a simple algebraic equation

that includes only two parts of the system. Newton's laws of motion mislead scientists of the 17th century and all those that followed in his footsteps.

Early 20th-century theoretical physicists concerned themselves with very small entities - atoms and subatomic particles. By a process of mathematical reasoning from observations made using new techniques they came to two, what for them were, astonishing conclusions. The first was that atomic and sub-atomic particles do not exist continuously, but only intermittently. The second was that it is not possible to determine both the position and the velocity of an atom or subatomic particle from one and the same observation. They would not have been astonished if they had possessed a more adequate concept of what it means to come to know something (Section 3.7). What they discovered gives us a more viable concept why physical entities, all physical entities, move as they do than does the Galilean-Newtonian conception with which they began. These discoveries were the result of looking at entities in a hitherto unexplored realm where entities are very small and move at high velocities. They were made in spite of the fact that the scientists used an inadequate and misleading mathematical methodology and a faulty initial assumption about the nature of motion (inertia).

Our approach to describing and explaining these surprising findings will be in terms of the alternative assumption of what it means to come to know something. When I say that I see (or feel, hear, smell, taste) a physical entity A, I mean that A is an entity in an episode of experiencing in which I am the subject, one episode in a temporal series of similar episodes. These episodes are brief, occurring at a rate of about half a dozen per second. In each of these episodes I experience an A like entity (A_1, A_2, A_3...) in which the differences are very small. When I experience this series as a series in a further episode by bringing all the previous

experiences in the series forward (memories), I see 'A' (a thought entity) as one enduring entity.[14] Nevertheless, 'A' does not exist continuously, but only intermittently, and each of the As is different, if only marginally.

When I also see that in each experience of the A-like entity is in a relatively different position in the same reference frame (whole), I say that in the interval between experiences A has moved. But, just as physical entities do not change from one experience of them to the next (Section 3.1), so too, they do not move. Each of the As in the series is a different (but similar) A in a different (but similar) reference frame. In our experiences of common entities in our surroundings, like the sun or a cricket ball, the intervals do not register, and we seem to be seeing smooth, continuous movement. With very small entities like subatomic particles, the differences in relative positions between one episode and the next are large, and it is no longer possible to see them as 'moving' smoothly; rather they seem to jump from one relative position to the next. During an interval there is nothing to see. This is precisely what 'new' theoretical physicists discovered. Unfortunately they did not understand their finding in this way, probably because they were unable to drop their inherited Newtonian conception of movement of continuously-existing entities.[15]

It is important to realise that the foregoing description applies equally to the 'movements' of all entities irrespective of size.

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[14] I am summarising here the conclusions reached in Sections 3.1 and 3.2. For a more detailed and comprehensive account, see Jackson (2013 b).

[15] It is important to remember that with this explanation the observer (the 'I' that observes) also does not exist continuously, but appears and disappears with the object observed.

Werner Heisenberg's famous uncertainty principle states that both the position and velocity of a moving subatomic particle cannot be determined from the same observation. That this should be so should now also be obvious from the view of 'motion' outlined in the preceding paragraphs. Position can be known from a single experience of an A-like entity in a temporal series of A-like entities, but the 'velocity' cannot. To come to know 'A's' 'velocity' it must be experienced in two successive appearances. 'Velocity' is the relative distance (within the whole) between, say, A_1 and A_2 in successive experiences divided by the length of the time interval between them. The units of measurement are, for distance, a subdivision of the longest dimension of the whole (its reference frame), while the unit of time is the interval between the appearance of A_1 and A_2. Thus, the velocity of 'A' in the interval between the appearances of A_1 and A_2 will be 1. Say that the distance between 'A' in appearances A_1 and A_2 is half that of the longest dimension of the (similar) systems in which they appear, the 'velocity' of 'A' will be one half an 'A' unit divided by one unit of time. If distance is one-hundredth of the longest dimension of the system, and the time interval between A_1 and A_{10}, velocity will be 0.01 divided by 10. This is the same calculation as is used in Newtonian physics, and also essentially the same definitions of distance and time. Needless to say, 'the' position of the entity 'A' cannot be stated because two positions are involved. 'Velocity' is a thought entity that follows the two observations of the physical entities.

The foregoing description of velocity makes it perfectly understandable why the position and velocity cannot be determined from a single observation. And it applies to all entities however large or small. Because this discovery was unexpected, the 'new' physicists were at a loss to explain it simply. However, this discovery and that of 'jumping' particles are important. They could have made important contributions to the formulation of viable

and believable alternative assumptions about the nature of the world and of actual entities.

4.2 Space-time

In the first decade of the 20th century Albert Einstein developed his theory of special relativity. He began by affirming, if only tacitly, the following assumptions of Newtonian science:

1. A self-existent world composed solely of physical entities. Forces, energy, light and fields are included in the term 'physical entities'.
2. A person as an observer of physical entities.
3. A mechanistic conception of how a person comes to know that there are physical entities in the world 'out there' and how they move in relation to one another.
4. Time and space are absolute; that is, they are receptacles. There is one common time receptacle for all observers, and one common space receptacle for all observers. In other words, observers are in the time and space receptacles.
5. The mathematical method of describing natural phenomena is an adequate and the only means of representing physical phenomena.

He then proceeded to extend assumption 1 by further defining light entities as quanta of energy. These travel from light-emitting entities to light absorbing entities at a definite, finite velocity. As was argued in the previous section, energy is itself a reification of a relationship. And so, he defined one reification (light particles) in terms of another (energy), further confounding the original logical mistake. It is this concept of energy quanta that was taken up by physicists in the third decade of the century as the basis

for quantum theory which so disconcerted Einstein with its denial of the Newtonian assumption of causation. That development awaits our attention in the next section. What concerns us in this section is the logical extension of assumption 4 concerning time and space necessitated by his definition of light as quanta of energy moving through the space receptacle.

Though Einstein invented the concept of light quanta, he was never comfortable with it; near the end of his life he admitted that 'all these fifty years of pondering have not brought me any closer to answering the question, What are light quanta' (Isaacson, 2007, p. 101). Seemingly, there is no answer.

Einstein realised that if light is essential in coming to know of the presence of a physical entity, and that light takes time to travel from that entity to the observer's eye, there is a delay in the process of coming to know. Thus, for example, I see the sun begin to rise above the Eastern horizon in the morning at seven o'clock, but the sun must 'really' have begun to rise above the horizon a few minutes before seven o'clock.

Einstein's thought experiments dealt with the relative movements of extra-terrestrial entities. The distances between observed and observer are very great and thus the time-lag in the process of coming to know is considerable, from a few minutes in the case of an observer on Earth viewing other entities in the Earth's solar system, to many years when he or she is viewing distant stars. As a result, observers on two different planets, one near an event (in a common space receptacle), and the other further away from it, would come to know of it at different times, time being assumed to be a common time receptacle of both. The same two observers viewing two events, say A and B, at a great distance from one another, could even come to know A and B in a different sequence in a common time receptacle. One observer

would come to know A before B while the other would come to know B before A. On the basis of this conclusion, Einstein realised that an event cannot be considered to have a single unique time of occurrence in a common time receptacle for all observers nor a unique position in a common space receptacle. To integrate times and positions into a single view of the totality of all times and positions so that every observer would be able to relate logically his or her experiences of A and B to every other, he created the concept of a single, common space-time receptacle. This was a process of mathematical reasoning and the concept was described mathematically.

Since none of the mainstream assumptions (1 to 5 above) is logically tenable, Einstein's deductions from them leading to his special theory of relativity are untenable. His theory is misleading and thus unhelpful in constructing a useful worldview.

Had Einstein begun with the assumptions that

1) the world is a thought entity, created by the integration of all of a person's previous experiences of all four types of entities and is personal to him or her alone, and

2) that time and space are relative to each observer,

he would have arrived at an entirely different concept of relativity. He would have seen that to relate his or her world to those of others with whom he or she interacts, he or she must employ a concept of simple relativity. In other words, he or she would assume that his or her picture is a view of a common world, but from a relative position within it. This is precisely what each of us does every minute of every day in order to relate our world to those of everyone else. It is no doubt difficult at times, but we manage reasonably well. Einstein's alternative conceptual model would only make it more difficult.

4.3 Causation

In the third decade of the 20th century the physicists who created quantum mechanics continued to look at parts and not at wholes. When they studied the movements of a single molecule in a sealed flask of a pure gas, they observed that it moved here and there in a jerky manner. They were convinced that the reason for each of these movements could be understood as being the result of a collision with or near-miss by other molecules in terms of the laws of Newtonian mechanics, but to do so for each and every molecule in the flask at every moment in time appeared to be a practical impossibility. The means by which they attempted to circumvent this problem came to be known as the concept of statistical mechanics.

To explain this concept they ask us to visualise, for example, a cubicle box with four equally-sized cubical compartments. The compartments are interconnected by openings in their shared interior walls. The box is filled with a gas and sealed. One of the molecules is coloured, while the rest are colourless. At any particular moment of time, the coloured particle will be found in one or another of the four compartments. In a series of observations its position, in terms of which compartment it is, is noted. In any series of, say, 100 observations, it will be found to be in any one compartment about 25 times. Observing one compartment only, the coloured molecule will be found to be present on average one time in four observations. "On average' means the average of many repeated sets of four observations. In statistical terminology, it is said that in any one observation there is a one in four likelihood of seeing the coloured molecule, or a probability of 0.25 of seeing the coloured molecule. In any one observation there is no certainty, before the observation is made, about whether it will appear or not.

At this point the quantum physicists made a logical mistake. They said that because they could not predict definitely whether or not the coloured molecule would appear in any one observation of a compartment before the observation was made, its movements could not be said to be the result of the operation of the laws of Newtonian mechanics. Therefore these laws are wrong. The movements of the coloured molecule were random, uncaused. David Shiang (2008, Chapter 5) pointed out this mistake. The 'laws' of statistical mechanics he said are derived from multiple observations, and cannot therefore logically be used to explain single observations.

Had the quantum physicists questioned why the concept of statistical mechanics brings some order to these observations, they would have perhaps seen that it could be an expression of a wider, more subtle working of causality than is pictured by the Newtonian laws. To have done so, they would have had to shift their gaze from single molecules to the whole system of molecules in the box. This they were unable to do.

Until the mid-twentieth century, scientists in fields other than physics continued to operate according to the protocol of Newtonian science. In the latter half of the century, however, a few of them began to take seriously the unexpected and seemingly unexplainable behaviour of complex physical entities like plants, animals and human beings. These few scientists began to 'see' organisms as dynamic systems and the need to describe these systems as systems. This was a shift from 'seeing' parts to 'seeing' wholes, a decisive break with tradition. But it was not a complete break with mainstream science, that is, with the worldview that legitimises it, because the assumptions of that worldview were not questioned. Here are two examples of this. First, scientists studying systems still continued to rely on mathematics (both geometry and algebra) in this attempt to describe them. We have

seen (in Section 3.5) that this procedure is logically untenable since it relies for its justification on the assumptions that entities are independent, displaying their own intrinsic and unique attributes. Second, no attempt was made to explain the forms and patterns of behaviour of systems in a fundamental way at the level of assumptions. Saying that forms and patterns of behaviour emerge spontaneously in complex system does not explain how they appear in terms of causal connexions. All this does not lend much weight to the claim they made to be creating a 'new' science.

4.4 Coming to know

'New' scientists claim to have replaced the assumption that the process of coming to know is a result of detached observation by a person of the world 'out there'. The process of coming to know is, according to this assumption, a result of the activities of neural networks. This process is fed by a stream of sensory inputs from the world 'out there'. They termed this process 'bringing forth a world'.

> According to the Santiago theory [of Humberto Maturana and Francisco Varela], cognition is not a representation of an independent, pre-given, world, but rather a bringing forth of a world. What is brought forth by a particular organism in the process is not the the world but a world, one that is always dependent upon the organism's structure. Since individual organisms within a species have more or less the same structure, they bring forth similar worlds.... Maturana and Varela do not maintain that there is a void out there.... There is a material world, but it does not have any predetermined features... They assert that 'no things exist' independent of the process of cognition. There are no objectively existing structures; there is

> no pre-given territory of which we can make a map – the map-making itself brings forth the features of the territory.
>
> (Capra, 1997, pp. 263-4)

This formulation of coming to know is clearly a compromise between accepting and rejecting the assumptions of a world 'out there' and coming to know as a process in which exact images of entities 'out there' are created 'in here'. It is reminiscent of Immanuel Kant's concept of cognition. It clearly does not constitute a rejection of these two mainstream assumptions.

4.5 A summing up

There does not appear to be any evidence, explicit or implicit, that 'new' scientists replaced any of the assumptions of 20th-century mainstream scientists. Concerning the assumption that physical entities are continuously existent, quantum theorists have discovered that it is not borne out by the results of their research. What they did find was that subatomic particles are only intermittently existent. This accounts for what they term 'quantum jumps'. They also discovered what they termed the 'uncertainty principle'. I have argued that though these findings were unexpected, given their initial mainstream approach, they make very good sense in terms of the common, everyday experience of large entities, and that this is a welcome new development. It did not, however, lead them to question their assumption about the nature of physical entities fundamentally.

Concerning the correct ways to do research, scientists studying systems have replaced them with ways that direct scientists to look at the whole rather than the parts of entities. This too is a welcome development, but they have offered no justification, in terms of alternative assumptions, for these new research methodologies.

Einstein began his enquiry into the nature of time and space by assuming the Newtonian concepts of absolute time and space. His results seemed to require a rejection of these assumptions. However, we have seen that these results were due to faulty reasoning and cannot be accepted as valid. If the arguments advanced for these faulty lines of reasoning are accepted, it will be seen that Einstein ended up where he began. Instead of two separate receptacles, one for time and one for space, he proposed one receptacle in which time and space are combined.

On balance, therefore, the sweeping claim to have created a new science is not justified. This task remains to be taken up systematically and in earnest by scientists and society as a whole in the present century.

Finally, I cannot resist quoting from Koestler's *The Sleepwalkers.*

> Compared to the modern physicist's picture of the world, the Ptolemaic universe of epicycles and crystal spheres was a model of sanity.
>
> (Koestler, 1959, p. 540)

5
Alternative science

We have seen in Chapter 3 that mainstream scientists of the 20th century did not question traditional assumptions in any way. They saw no need to. In fact, they were largely unaware of their assumptions, or, indeed, that they had any assumptions at all. 'New' scientists (Chapter 4) recognised their assumptions to some extent and the role they play in their work, but for the most part failed to create effective alternatives. As was said in Chapter 2, the former remained entirely in the shadow of Newtonian science, while the latter were aware that their work was overshadowed by inherited assumptions and they made an effort to move out of the shadow.

The positive achievements of 'new' scientists, while falling short of breaking decisively with tradition, are, however, noteworthy. There was the beginning of a shift in focus from the parts of entities to the whole. In the realm of physical actual entities this was most evident among those studying large, complex entities (biology). The results of those scientists studying very small, relatively simple entities (subatomic entities) pointed in the same direction, that is, towards a concept of wholeness. Unfortunately, these scientists did not realise this. I say this because they continued to describe their results in ways that they used to describe parts of wholes, namely, algebraic equations that described the relative movements of self-sufficient parts within wholes. The logical inadmissibility of this procedure was pointed out in Section 3.5. The results were confusing, which should have led them to back up and examine their assumptions. This they were unable to do. In particular, they would have had to employ an alternative

assumption of what actual physical entities are to make sense of the phenomena they termed 'quantum jumps' and the 'uncertainty principle'.

A few scientists, here and there, in diverse areas of study, did resolutely turn away from their inherited assumptions and articulated promising alternatives. The new evolutionary perspective of the earth as a whole and of all its parts/ inhabitants, the ecological perspective and systems theory, gave rise to unease among scientists in these new areas of research because traditional Newtonian science seemed vaguely, but increasingly, irrelevant to the task of describing and explaining phenomena they were studying. As a result some of them began tentatively to formulate alternative concepts of causation: Goldsmith's the 'Way', Sheldrake's 'morphic fields', and Howard's 'Nature's farming'. Whitehead formulated an alternative concept of an actual entity, placing it in the context of an alternative worldview which he spelled out at the same time. Howard in addition spelled out a new research protocol appropriate to the science of wholeness. In this chapter I will describe the work of four scientists and argue that their alternative assumptions deserve our closest attention if we are to create a more logical, coherent and effective worldview to inform the scientific enterprise in the current century.

5.1 'The Way'

The ecologist Edward Goldsmith in his book *The Way: An Ecological Worldview* formulated an alternative explanation for the complex patterns of events that characterise ecosystems, human societies and their interactions. He realised that the laws of Newtonian science are unable to do this satisfactorily. In fact, their deployment in attempting to understand and manage systems results in destabilising them. He saw more clearly than most people that in looking at systems, one must focus on the system as a

whole and not on the separate entities and events which are its parts. Each system is, in turn, a part of a larger system, and together they form a vast hierarchy. He termed this the 'Gaian hierarchy'.[19] Other terms for this concept of order, more extensive in their scope, are 'the harmonious unity of nature' (Goldsmith, 1998, p. 46, quoting Alexander von Humboldt) and the 'Great Ordering Oneness (Goerner, 1999, p. 165). Every entity in this Gaian hierarchy behaves as it does because it is a part of the hierarchy; it cannot behave otherwise.

The terms 'nature' and 'Oneness' are intended to indicate the existence of a single order that determines the behaviour of every entity in the world. Goldsmith also uses the term 'homeotelic' (from the Greek homeo, same and telos, goal) to designate the 'normal behaviour that serves to maintain the crucial order of the whole' (Goldsmith, 1998, p. 472).

These descriptions imply the assumption that the order of the whole is immanent in each of the parts of that whole. Goldsmith acknowledges this explicitly when he writes that the behaviour of the parts of the whole (Gaian hierarchy) is guided by 'dynamic model' within each of them (ibid., p. 57). Their behaviour is a manifestation of the order of the whole acting in and through the part. This concept thus does not recognise 'causes' as that term is used in mainstream science; no one event (the interaction of entities) causes another.

The 'Way' in the book's title refers to the role of each part of the whole, which it follows in order to maintain the structural and functional integrity of the whole.

To elaborate on these brief introductory statements Goldsmith further says:

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[19] The name 'Gaia' for the earth became current from the 1980s onwards as a result of James Lovelock's 1979 book *Gaia: A New Look at Life on Earth*.

> Life processes at all levels of organization ...are designed according to the same plan, being purposeful, dynamic, creative and intelligent. What is more, their adaptive strategies are all geared to maintaining the stability or homeostasis of the entire Gaian hierarchy - a *sine qua non* for the maintenance of their own homeostasis.... In addition, the larger systems control and coordinate the behaviour of their constituent parts, Gaia herself co-ordinating the behaviour of all the constituent members of the hierarchy and further assuring in this way that their behaviour remains that which will assure overall homeostasis.
>
> (Ibid., p. 126)

> A process, however, is an abstraction unless it has a spatial aspect, just as any entity is an abstraction if seen only temporally. The temporal or spatial abstractions in terms of which we are accustomed to think about Gaia are in fact but different aspects of the same reality, the spatio-temporal system that is Gaia. It follows that there must be a perfect correspondence between the temporal Gaian abstraction and the spatial Gaian abstraction, just as there must be a perfect correspondence between our digestive process and our digestive system seen as a physical entity.
>
> (Ibid., p. 126)

A final feature of Gaia, seen as a spatial abstraction, is that it displays order, which in a spatial abstraction corresponds to purpose in a temporal abstraction. In a hierarchical spatio-temporal system this means that the parts must behave according to the 'model' of the whole within them in order to maintain its stability and thus their own stability (Ibid., p. 127). This is a further

departure from the thinking of mainstream and 'new' scientists for whom the concept of purpose in the context of science is taboo.

Another valuable feature of Goldsmith's book is the recognition of the antiquity and universality (leaving out modern science) of the assumption of the Great Ordering Oneness. Goldsmith studied ancient cultures and those few that have not yet been overwhelmed by contemporary global culture and found that all of them share this assumption. It is described variously, but in essence all are the same (Ibid., Chapter 61). One rendering of the Indian Vedic version reads:

> It would be natural to seek the content of *Rta* but the quest would be doomed to failure because *Rta* is ...neither a single law or form nor any system of laws or forms. It is rather the ultimate presupposition of all specific types of order or systems of laws..., itself not a limited form but a whole that is self-determined and self-expressive in infinite variety.
>
> (Pande, 1990, p. 25)

The historian of Chinese science, Joseph Needham, describes *Li* in this way:

> *Li*, then is rather the order and pattern in Nature, not formulated Law. But it is not pattern thought of as something dead, like a mosaic; it is dynamic pattern as embodied in all living things, and in human relationships and in the highest human values.
>
> (Goldsmith, 1998, p. 215)

A further noteworthy feature of the concept of the Great Ordering Oneness illustrated by Goldsmith's book is its persistence. The essential form of the concept somehow endures, even amongst

people in cultures in which it does not achieve overt expression. Thus in 20th-century Western culture, when scientists here and there felt the need for an alternative assumption about the nature of causation, it spontaneously found expression. It felt right. Generalising, we might say that when its time has come, a concept that has appeared once, anywhere at any time, can appear – or reappear – spontaneously. Goldsmith himself does not offer an explanation of how this might happen.

Goldsmith has not fully been able to free himself of all mainstream and 'new' scientific assumptions. For example, he attempts to account for the presence and activity of this 'model' in terms of brain functioning (Ibid., pp. 57-8). To have done otherwise he would have had to assume that all actual entities have brains, even atoms, electrons and all the other subatomic particles physicists speak of. The processes of perceiving a model, understanding it and finally acting in accordance with it cannot be entertained unless life is accepted as an inherent feature of all actual entities. Goldsmith did not question the mainstream assumption that life is 'nothing but' an emergent property of large and complex entities, and that small and simple ones are dead.

A superficial reading of *The Way* does give the impression that Goldsmith agrees that all entities are living, but this impression is erroneous. Consider the following passages which Goldsmith endorses:

> 'Traditional man knew that the world is one, that it is alive, hierarchically organized and that all the myriad *living* things that inhabit it are closely interrelated, and co-operate in maintaining it integrity and stability.
>
> 'Plato saw it [the world] as "a living creature, one

> and indivisible, containing within itself all *living* creatures that are by nature akin to itself."
>
> 'The stoics, Hughes tells us, also saw the cosmos as a sentient being, that is rational, harmonious, and of which all *living* things are part.'
>
> (The italics in these quotations are mine)
>
> (Ibid., p. 116)

These passages make it clear that Goldsmith does not consider that dead, non-living entities are covered by the Great Ordering Oneness. James Lovelock (Lovelock, 1977) also excludes what he considers to be non-living entities from his concept of Gaia, though the living components (the 'biosphere') interact with them, regulating, for example the proportions of gases in the atmosphere and the pH of the oceans.

Another problem with Goldsmith's conception of the Great Ordering Oneness is that it contains two contradictory definitions of the concept of the subject (the person in mainstream scientific thought). On the one hand, a person is bound like every other entity to act in accordance with the requirements of the Great Ordering Oneness. On the other hand, a person can choose to recognise and act upon those requirements or not. He or she can and sometimes does act contrary to the pattern of the Ordering Oneness. If he or she does act contrary to the pattern or 'model', his or her actions are 'anti-way' (see Chapter 64 in *The Way*). To phrase the matter in terms of two simple assertions:

1. Every entity is part of the whole and therefore must abide by the requirements of the whole.
2. Some parts of the whole, namely human beings, do not act in accordance with the requirements of the whole, but of their own individual, independent volition.

These two assertions contradict one another. Whitehead pointed this out in general terms more than half a century before Goldsmith wrote *The Way,*[20] but Goldsmith, in spite of being familiar with Whitehead's work, failed to spot this contradiction in his own work. Needless to say, any such logical inconsistency in the definition of one of the formative elements of experiencing enfeebles the entire worldview of which it is a part. The resolution of this contradiction, it seems to me, is to say that the Great Ordering Oneness determines human behaviour down to the most minute detail, with no exceptions. If a person develops an awareness of the wholeness in his or her own thoughts, emotions and feelings that he or she did not have earlier, it is also because of the current pattern of the wholeness. This movement in awareness is an indication that the whole is attempting to regain its structural integrity, and the person's 'becoming aware' is an aspect of this attempt.

Goldsmith has conspicuously omitted any consideration of how the pattern of the Gaian hierarchy as a whole, in both its structural and functional aspects, varies over time. In other words, he failed to identify the cause of novelty – the appearance of forms never experienced before, forms which could not be anticipated. Whitehead had pointed out earlier that novelty is a feature of the functioning of all systems, scarcely noticeable in simple systems, but more so in complex ones. When it is said that something is novel we do not necessarily mean that it is uncaused, but that the causal mechanism is not obvious. I wish to suggest that the best we can do by way of explanation is to say

[20] 'Western peoples exhibit …two attitudes [that] are really inconsistent…. A scientific realism, based upon mechanism, is conjoined with an unwavering belief in the world of men and higher animals as being composed of self-determining organisms. This radical inconsistency at the base of modern thought accounts for much that is half-hearted and wavering in our civilization' (Whitehead, 1925, p. 76).

that a novelty is a result of the internal logic of the system's structure and functioning. If this is so, what mainstream and 'new' scientists call a 'mutation' in form is not a chance event.

Goldsmith also did not challenge the mainstream and 'new' scientists' assumptions about actual entities, the observer, time, space and coming to know, either. The result is that his worldview is highly incoherent, and will not lead to effective action. He failed to realise that his worldview is also a system, a system of thought entities. Nevertheless, his concept of order can, in my opinion, be an important, part of a more complete and effective worldview – a worldview which is implicit in his concept of order, but which he failed to grasp in its entirety.

5.2 The presence of the past

Actual entities that we have experienced in the past often recur, be they physical entities, thoughts, emotions or feelings. When entities appear we recognise them by relating them to entities which preceded them. When thus related they take on distinctive identities. We then invent names for these identities. These names are generic and specific: this is a chair; it is my chair, an easy chair, and its cover is frayed. 'Chair' is its generic name, while the rest are specific to a particular chair. After its first appearance, similar chairs continue to appear at intervals. These vary somewhat in terms of their specific features. Eventually these chairs cease appearing. It is said to have 'disappeared'. To illustrate this with another example: this entity is a cow, my cow and her name is Laxmi; she is born, grows up, ages and dies, though when she appears she is always Laxmi. At death she disappears as a physical entity but when living she produced a calf. When that calf appears for the first time it is immediately recognised as a baby cow. Then we notice its sex, colour, distinguishing features, etc., all those features that make her a particular cow. I name her Nandi. When

I see Nandi, I sometimes remember her mother Laxmi, that is, Laxmi reappears to me as a thought entity. How are we to explain this recurrence of particular entities and their persistence?

We can only say that an entity reappeared because of the similarity of the forms of the two entities, the physical entity I experience just now and the thought entity (memory) that I experience immediately afterwards. The questions about the recurrence and persistence of entities is thus about the recurrence and persistence of particular forms over temporal series of experiences. In mainstream science the form of an entity is attributed to the way its parts are assembled, and the way they are assembled is determined by their own inherent forms defined by their primary attributes. It is thus being assumed, in effect, that the sum of the forms of the parts is the form of the whole. But we have seen (in Section 3.5) that the whole is more than the sum of the parts because the so-called primary attributes of each part are not its attributes but an indication of its relatedness to all the parts of the whole to which it belongs. This being so, there is no option to saying that the forms of the parts of an entity are determined by the form of the whole. Laxmi's form, as I experience it, is more than the total of her legs, head, udder, etc., or my memory of her, or my affection for her, or the warmth of her body as I snuggle up to her flank on a cold winter's morning whilst milking her, more than the sum of all these. Further, Laxmi's form is determined by the place she occupies in the whole of my farming operation, and so on up to the hierarchy of ever-wider contexts to the planet and beyond.

The form of an entity is not immutable since it is somewhat different in successive appearances, but not so much different that I fail to recognise it. This suggests that a form possesses a core pattern that is constant through a series of appearances. This pattern can and does vary, but not to the extent that I fail to recognise it each time it appears. Thus Laxmi remains a cow

throughout her life. Over her life span many of the features that make her a specific cow vary with time and the concomitant variations in the contexts in which she appears, but these seem to occur gradually over the series so that I do not fail to recognise her as the same specific cow. To elaborate: if I am shown a snapshot of Laxmi as a small calf, and another as a mature adult, I may fail to recognise her as the same animal, but if I have also seen a whole series of snapshots of her in between these two, this difficulty does not arise.

It is now possible to rephrase the question asked at the beginning of this section: how are we to explain the recurrence of particular entities and processes and their persistence. We will ask: how are we to explain the recurrence of the forms of entities, the relative persistence of these forms over time, and their evolution.

The stage has now been set for a consideration of Rupert Sheldrake's suggested answers to these questions. In the Introduction to his book *The Presence of the Past: Morphic Resonance and the Habits of Nature* (Sheldrake, 1988) he describes his assumption about the nature of causation in the following words:

- This book explores... suggests that natural systems, such as termite colonies, or pigeons, or orchid plants, or insulin molecules, inherit a collective memory from all previous things of their kind, however faraway they were and however long ago they existed. Because of this cumulative memory, through repetition the nature of things becomes increasingly habitual. Things are as they are because they were as they were.

- Likewise, as a swallow grows up, it flies, feeds, preens, migrates, mates, and nests as swallows habitually do. It inherits the instincts of its species through invisible

influences, acting at a distance, that make the behaviour of past swallows in some sense present within it. It draws on and is shaped by the collective memory of its species. All humans too draw upon a collective memory, to which all in turn contribute.

- All these possibilities can be conceived of in the framework of a scientific hypothesis, which I call the hypothesis of formative causation. According to this hypothesis, the nature of things depends on fields, called morphic fields. Each kind of natural system has its own kind of field: there is an insulin field, a beech field, a swallow field, and so on. Such fields shape all different kinds of atoms, molecules, crystals, living organisms, societies, customs, and habits of mind.
- Morphic fields, like the known fields of physics, are non-material regions of influence extending in space and continuing in time. They are localised within and around the systems they organize. When any particular organised system ceases to exist, as when an atom splits, a snowflake melts, or an animal dies, its organising field disappears from that place. But in another sense, morphic fields do not disappear: they are potential organizing patterns wherever and whenever the physical conditions are appropriate. When they do so they contain within themselves a memory of their previous physical existences.
- The process by which the past becomes present within morphic fields is called morphic resonance. Morphic resonance involves the transmission of formative causal influence through both space and time. The memory within the morphic fields is cumulative, and that is why all sorts of things become increasingly habitual through repetition. When such repetition has occurred on an astronomical

> scale over billions of years, as it has in the case of many kinds of atoms, molecules, and crystals, the nature of these things has become so deeply habitual that it is effectively changeless, or seemingly eternal.
>
> (Sheldrake, 1988, pp. xvii-xix)

Later on in the book he defines the three concepts 'morphic units, morphic field and morphic resonance, more fully as follows:

> **morphic unit:** A unit of form or organisation, such as an atom, molecule, crystal, cell, plant, animal, pattern of instinctive behaviour, social group, element of culture, ecosystem, planet, planetary system, or galaxy. Morphic units are organized in nested hierarchies of units within units: a crystal, for example, contains molecules, which contain atoms, which contain electrons and nuclei, which contain nuclear particles, which contain quarks.
>
> **Morphic field:** A field within and around a morphic unit which organizes its characteristic structure and pattern of activity. Morphic fields underlie the form and behaviour of holons or morphic units at all levels of complexity. The term morphic field includes morphogenetic, behavioural, social, cultural, and mental fields. Morphic fields are shaped and stabilized by morphic resonance from previous similar morphic units, which were under the influence of fields of the same kind. They consequently contain a kind of cumulative memory and tend to become increasingly habitual.
>
> **morphic resonance:** The influence of previous structures of activity on subsequent similar structures of activity organized by morphic fields. Through morphic resonance, formative causal influences pass

> through or across space and time, and these influences are assumed not to fall off with distance in space and time, but they come only from the past. The greater the degree of similarity, the greater the influence or morphic resonance. In general, morphic units closely resemble themselves in the past and are subject to self-resonance from their own past states.
>
> (Ibid, p. 371)

Before commenting on these concepts, I would like to suggest that the word 'field' in these definitions be taken in the sense that has been explained in Section 3.1, that is, as a reification of a system of relationships. As for the word 'hypothesis', I suggest we disassociate it from its mainstream scientific context and consider it to mean an assumption. Sheldrake, like Goldsmith, did not entirely free himself from mainstream scientific assumptions, but we must not let our attention be distracted from understanding the significance of his remarkable new concept of causation. My contention in this chapter is that this concept can be seen to be congruent with the innovations of Goldsmith, Whitehead and Howard if we divest their concepts of the elements of mainstream and 'new' science which lurk in them. The word 'morphic' refers to the forms of entities. It is an adjective.

It will be evident that the 'pattern of the whole' described in Chapters three and four might be thought of as a morphic field. Goldsmith's 'Gaian hierarchy' might also be thought of as a huge morphic field subsuming the morphic fields of all the individual entities which are parts of it. Sheldrake himself is explicit in this matter:

> The universe contains structures of activity [dynamic systems of parts] at all levels of complexity and magnitude, from subatomic particles to galactic clusters. *Ex hypothesi*, all of these are associated with

> characteristic morphic fields. Perhaps it makes sense to think of the entire universe as an all-inclusive organism. If so, then by analogy with all the kinds of organism within it, the entire universe would have a morphic field which would include, influence, and interconnect the morphic fields of all the organisms it contains.
>
> (Ibid., p. 303)

The advance of this concept over those of the 'pattern of the whole' and the 'Gaian hierarchy' is that a morphic field, once created by the appearance of a new entity persists even after the entity which informed it disappears. It then can serve as a template for the creation of new entities of the same general form in the future, anywhere and anytime. Since it is effective across time and space, we must conclude that it is located nowhere and nowhen in particular, but beyond both space and time.

Sheldrake realised the need to question two more of the assumptions of modern science, namely life and actual entities. About life, he quotes Whitehead with approval:

> In Whitehead's phrase organisms are 'structures of activity' at all levels of complexity. Even subatomic particles, atoms, molecules and crystals are organisms, and in some sense alive... life is not something that has emerged from dead matter.... All matter is alive. The organizing principles of living organisms are different in degree but not different in kind from the organizing principles of molecules or of societies or of galaxies. 'Biology is the study of larger organisms, whereas physics is the study of the smaller organisms' ....physics is also the study of the all-embracing cosmic organism, and of the galactic, stellar and planetary organisms which have come into being within it
>
> (Ibid., pp. 54-55)

In this passage he also questions the mainstream and 'new' scientists' assumption about actual entities. If all physical entities, for example, are living, then they are not lifeless material entities with primary attributes, pushed and pulled about by forces. Further, he recognises types of actual entities other than physical and sees them as forming systems which also create morphic fields. In all these ways his overall work is a distinct advance over that of Goldsmith.

Sheldrake's concept of morphic resonance, confirms and extends Goldsmith's concept that the form of an entity or process is that of the whole of which it is a part. It also suggests how the pattern of the whole determines the forms of its parts. 'The pattern of the whole' becomes more definite, and gives us a picture, so to speak, of an entity which we are able to contemplate and by means of which deepen our understanding. In the next section we shall see that Sheldrake's concept of morphic resonance fits logically into the worldview constructed by Whitehead. Placing it in that larger context will further enhance our understanding of it.

The foregoing narration of Sheldrake's concept of morphic resonance deals with only what I have termed the core elements of the forms of entities, that is, those elements which serve to define classes of entities like cows, chairs, mountains, etc. The variable elements which distinguish individuals within classes, the features which make Laxmi who she is, or chair into my easy chair, are not accounted for. Any complete explanation, however, must deal also with these individual specific elements of form. The concept of morphic resonance does not explain why long after Laxmi's death, I can remember her in detail, as a definite individual. This short-coming in Sheldrake's concept of morphic resonance awaits our consideration in the next section.

5.3 Actual entities as processes

In previous chapters we have seen that by assuming that the world exists independently of any observer and that it exists

continuously, that it consists solely of physical entities with primary attributes, mainstream and 'new' scientists created problems for themselves which they could not plausibly overcome, and which indeed cannot be overcome. They could not explain observations, or the observer, or the process of observation (coming to know). By assuming that material entities are insentient, inert lumps of matter, they were unable to explain how large collections of such entities spontaneously organise themselves into more or less stable patterns of activity in time and space, or in short, become lively. By assuming that actual entities are discreet lumps of matter, scientists described movements quantitatively in terms of size, weight, distance, direction, and velocity, but this approach broke down when it came to explaining in any comprehensive way why these lumps moved in relation to one another in the ways they do. These unsolved problems paralysed mainstream and 'new' science. These scientists seemed unaware of this and strenuously persisted in a 'business as usual' agenda, not stopping to examine their assumptions, or even recognising that the edifice of their science, any science, is erected on a foundation of assumptions.

Edward Goldsmith and Rupert Sheldrake, as narrated in the previous sections, did question basic assumptions and proposed distinct alternatives, but not systematically or completely. These piecemeal replacements, however, are not sufficient to rescue modern science from irrelevance. A complete new structure is needed.

Alfred North Whitehead was well aware of this need as early as the third decade of the 20th century. In his view, in Western science

> There persists ...throughout the whole period the fixed scientific cosmology which presupposes the ultimate fact of an irreducible brute matter, or material,

> spread throughout space in a flux of configurations. In itself such a material is senseless, valueless, purposeless. It just does what it does do, following a fixed routine imposed by external relations which do not spring from the nature of its being. It is this assumption that I call 'scientific materialism'. ...it is an assumption which I shall challenge as being entirely unsuited to the scientific situation at which we have now arrived.
>
> (Whitehead, 1925, p. 17)

In his 1929 book *Process and Reality: An Essay in Cosmology*, he proposed an alternative worldview, focusing on the concept of an actual entity as process, and at the same time attempted to ensure that the alternative concepts of the observer, space, time, life, causation and coming to know implied by this alternative concept of actual entities were made explicit. This alternative worldview will be described and evaluated in this section. In doing this, the larger significance of Goldsmith's concept of the Gaian hierarchy and Sheldrake's concept of morphic resonance will be demonstrated.

Donald Sherburne in his *A Key to Whitehead's Process and Reality* offers this introductory statement:

> This system is atomistic – i.e., like Democritus, Whitehead conceives of the world as composed of a vast number of microcosmic entities. But whereas Democritus is a materialist and views his atoms as inert bits of stuff, Whitehead presents an organic philosophy - each one of his atoms, termed, 'actual entities' or 'actual occasions', is an organism that grows, matures, and perishes. The whole of Process and Reality is concerned with describing the characteristics of, and interrelationships between, actual entities.
>
> (Sherburne, 1966, p. 6)

The term 'process' refers to a sequentially structured sequence of successive stage or phases. Three factors accordingly come to the fore:

1. That a process is a complex – a unity of distinct stages or phases. A process is always a matter of now this, now that.
2. That this complex has a certain temporal coherence and unity, and that processes accordingly have ...[a finite] temporal dimension.
3. That a process has a structure, a formal generic format in virtue of which every concrete process is equipped with a shape or format.

(Stanford Philosophy [Stanford Encyclopaedia of Philosophy], http://plato.stanford.edu/entries/process-philosophy/, consulted 26/7/2007).

Thomas McFarlane briefly elaborates on these statements.

> According to Whitehead, 'the actual world is a process, and the process is the becoming of actual entities' (PR, p. 22). These actual entities 'are the final real things of which the world is made up. There is no going behind actual entities to find anything more real' (PR, p. 18). An actual entity is not an inert and permanent substance, but a relational process of becoming: 'how an actual entity becomes constitutes what that actual entity is. ...Its 'being' is constituted by its 'becoming' (PR, p. 23). This process of becoming is a creative synthesis into one actual entity of its many relations to other actual entities. Whitehead calls the process of unification a concrescence of prehensions, where prehensions are the ways in which other entities are taken in by, and felt within the entity, and where

> the concrescence is the creative process of pulling together these diverse prehensions of other actual entities into a novel organic unity. Thus, 'actual entities involve each other by reason of their prehensions of each other' (PR, p. 20). Because of this mutual co-constitution, 'you cannot abstract the universe from any entity ...so as to consider that entity in complete isolation. ...In a sense, every entity pervades the whole world' (PR, p. 28).
>
> (T. J. McFarlane, http://www.integralscience.org/whiteheadbuddhism.html, consulted 2/2/14.)

In the following paragraphs I will describe Whitehead's system in my own words to the extent I understand it. Whitehead himself has said a strictly linear development of the concepts in his system is impossible because each presupposes all the others and the system as a whole. Thus the whole is addressed from a number of different perspectives, those of the individual concepts which are its parts. Each perspective will be fully understood only at the end of the entire narrative. My attempt to describe his system will necessarily be presented in the same way.

The ultimate units of manifest existence, or actual entities, are units of experiencing. They begin their careers as momentary appearances in the present. Having appeared, they then immediately disappear into the past where they continue to exist as subtle influences that Whitehead terms 'data'. Selected data are brought forward into the processes in the present by which further existents are created.

An actual existent thus has two aspects, or one can say exists in two modes. One is that of a momentary entity in the present, the entity that constitutes the satisfaction of an episode of experiencing. The other is that of a datum lying in the past which

embodies a latent possibility for the determination of future actual entities. The former mode passes into the latter, but an actual entity can and does also pass from a state of dormancy in the past back to the mode of immediate novel experiencing. In other words, a datum that is prehended in a new episode becomes an element in the constitution of a fresh existent in the present. What appears to be a passing from the past into the present, however, is only a figurative way of speaking. The actual entity can exist in both modes at the same time, since a datum, on being prehended, does not cease to exist as a datum in the past. Rather, it only yields up an impression of itself in the act of being prehended. If this were not so, the datum would not be enduring, would not be available for being prehended many times. Further, a datum is prehended, positively or negatively, by every new episode of experiencing, and is therefore, in a sense, present in the 'now' of every existent that follows it.

An experience is the sole, ultimate, actual unit of manifest existence in this worldview. And yet, experiences are not given entities, as are, for example, the atoms (or sub-atomic particles) of the materialist worldview, but are created by units of process. And therefore it could be said that a unit of process is the sole actual existent. A moment's reflection, however, will make it clear that a process requires definite, enduring entities as inputs. A process of bringing forth an actual entity involves the initial prehension of data (previously-created experiences in the past), their processing into a single, final entity which is the goal and end-point of an episode of experiencing. The data, however, were created by previous episodes of becoming. And so, it is evident that neither units of process in the present nor data in the past by themselves are the sole, ultimate units of existence. They are dependent on each other for their existence, and neither one can be thought of as prior to the other. Whitehead does not speculate on ultimate origins.

Whitehead's 'actual entities' is a definition required by the notion of that name introduced in Chapter 1. In the process of creating an actual entity, a driving force and guiding presence are necessary. This force and presence is 'life'. There must be order in the process and in the experience that results; this is ensured by a common, unitary, cosmic causal agency, or to use Goerner's expressive phrase, The Great Ordering Oneness. Physical entities, to be intelligible, must be demarcated one from another. This is the function of space. Individual phases of the process must be ordered one after another in logical sequences; this ordering gives rise to a sense of time. Finally, when an experience appears it must appear to someone. This someone is the 'subject' of the experience. The subject is said to 'come to know' the content of the experience in the very process of its creation.

5.3.1 Actual entities

The process by which an experience or an actual entity is created occurs in three stages: prehension, concrescence and satisfaction. The first stage consists of primary prehensions, while secondary and higher-order prehensions occur during the phase of concrescence. The final prehension, which brings the episode of experiencing to a close, is the satisfaction of the creative urge initiating and driving the process. Such an analysis is purely speculative since it occurs before the appearance of the existent. An analogy of struggling to create a new concept will, however, help us understand the nature of this process. We feel that the concept already exists, but is just beyond our reach. This 'reaching out' is the intense effort that we put forth. We already have the several pieces of the new concept, but cannot yet see how they fit together, or we feel that we have all the pieces except one, and cannot find that one. When finally we do fit the pieces together, or find the elusive piece, the whole concept suddenly crystallises. We are aware of its origins in terms of its parts, but the outcome

of putting them together is novel; it was not, and could not, have been anticipated. During the period of intense thinking, we have the feeling that some activity is going on 'behind the scenes', as it were, beyond our understanding.

The three concepts of 'prehension', 'concrescence' and 'satisfaction' need to be defined. The first of these is a 'reaching out' for something that is felt to already exist but which cannot be grasped. A prehension is what is finally grasped. What is grasped is a datum, an experience in the past. When finally grasped it is drawn towards the new experience that is being created. Many such data are individually prehended. Every experience that has ever occurred is a potential input for the creation of all subsequent episodes of experiencing, or, in other words, a datum to be grasped in an act of prehension. In theory any or all of these can be prehended; in practice prehensions are selective. Some data are selected, many are rejected. The rejection of a particular datum is also a feeling-charged act: it is a 'negative prehension'. This can readily be understood in terms of our everyday attraction to some features of our experience and aversion to others. Many features are simply ignored, but this may be construed as rejection as well. It is, like a positive prehension, a feeling and not a thought.

A prehension is a causal act. A feeling for a particular datum reaches out to it from the prehending entity (the new entity being created), grasps it, and carries it across to itself where it determines, together with other prehensions, the content of the new experience. However, a datum is not literally seized and carried across to the prehending new episode, for then it would disappear as a historical fact and so be unavailable as a datum for yet further episodes. They can, however, and do, yield up 'copies' of themselves – any number of them – without in any way losing their potency for the future.

What data are positively prehended and how they are later arranged in the phase of concrescence, are determined by the

operation of the common, cosmic, causal agency. It operates in the data prehended as well as in prehending new episodes.

Concrescence is the 'growing together' of the primary data prehended into one final datum, the prehension of which is the culmination of the entire process of bringing forth an experience. In doing this, however, there are conceptually distinguishable steps. Prehended primary data are compared, grouped, and arranged to give a number of secondary data which are prehended in turn. These operations may be repeated many times, with a progressive integration of the original data to fewer and fewer secondary and higher-order data. This series of integrations culminates in a single prehension which brings the concrescence, and the episode, to an end. These intermediate operations can be understood in the following way. Prehended data are compared and then grouped on the basis of the affinities that are found to form a nexus or 'systematic scheme of relatedness'. There are two distinct types of nexus, one based upon obvious sequential affinity and the other on the affinity due to a particular shared characteristic element. In the former a sequence of data is prehended, in which each datum immediately follows the previous one. This is termed a 'temporal nexus'. A shooting star is an example of a temporal nexus. In the latter, data share a characteristic primordial form or 'eternal entity', or they complement one another in some way. The individual data are not related to one another temporally. This type is a shared-characteristic nexus termed a society' by Whitehead. The common elements of everyday experience, crystals, stones, bacteria, worms, human beings, ecosystems, planets, suns, galaxies, are mixtures of temporal and shared-characteristic nexūs (plural of nexus).

First order, mixed nexūs of diverse types or patterns may subsequently be prehended as a group where there is a possibility

of their coming together to form a coherent scheme of relatedness or system. They are subsumed in such secondary concrescences by larger co-ordinating systems. Most nexūs are systems. Indeed, it is difficult to think of a nexus in which similar individual existents are merely piled up and do not display any organisation at all.

Simple systems may, in subsequent concrescences, be integrated into larger, more complex systems by a repetition of the same process by which the original individual data were compared and grouped into more inclusive systems. This process may be repeated any number of times, until large hierarchical structures are produced. A human being is a vast hierarchically organised nth order mixture of temporal and shared-characteristic nexūs.

A nexus, once formed, persists as a datum and, in future episodes, is prehended as a whole. Nexūs are the building blocks, as it were, of which future experiences are built. Thus increasing complexity may occur over a series of episodes.

Looking at a temporal nexus, the members are all seen to possess a common form. Consider the example of a stone. The successive stones appear to be the same entity through the entire series, giving the impression of a single, stable, enduring entity.

When all the grouped prehensions are grasped as a whole in one final prehension the process of concrescence is at an end. This culminating prehension is termed a satisfaction, since all desire for and grasping of data is over. The final prehension satisfies the need to understand the original collection of data in a coherent manner.

Actual entities as defined by Whitehead are only of one type, physical. Thoughts, emotions and feelings are not defined as actual entities in their own right, but are the ways the subject of an

experience, or the observer, responds to its experience of a (physical) actual entity. For example he uses the term 'feeling' in describing a prehension; it is the attitude of the actual entity in the making towards a datum that it will prehend. In Section 3.1, this assumption of only one type of actual entity of mainstream and 'new' scientists leads to many questions for which there are no logical answers. In discussing thoughts, emotions and feelings Whitehead often has recourse to physical explanations in terms of brains, transmission of particles through space and physical structures (like nerves). We can anticipate that a science based on the worldview Whitehead is presenting would subordinate the disciplines of human behaviour to the physical sciences, as they are subordinated in mainstream and 'new' science today.

5.3.2 Coming to know

The observer of phenomena is, in Whitehead's worldview, comes to know the entity that appears in an episode of experiencing concurrently with its creation.

5.3.3 The observer

The observer or subject of an experience, according to Whitehead, arises out of the process of creating the experience. The subject which is prehending a datum is the actual entity in which that datum becomes a part (see Sherburne, 1966, p. 9). He seems to be invoking the concept of emergence resorted to by mainstream and 'new' scientists when confronted with the problem of defining the observer (Section 3.2) and life (Section 3.6), a concept that is indefensible on logical grounds. He does recognise 'brute facts', for he quotes Plato to that effect (the same passage from the *Timaeus* that I quoted on page 12. But he insists that there is only one type of brute fact, actual entities as he defines them. This is the ideal of the Greek atomists and of Newton. In my

opinion this is the biggest drawback of Whitehead's worldview.[21] A better conception of the observer, I suggest, would be to accept that the observer is the 'I' who says 'I observe the process of the creation of this actual entity'. This I is a given feature of the process of the creation of every actual entity. It cannot be ignored, nor can the 'I' be defined in terms of anything else. It is a 'brute fact'. To admit this would have required Whitehead to say that actual entities are not the sole, ultimate entities required for an understanding of the world.

5.3.4 Life

Life too, for Whitehead, is a property of actual entities. He defines life as the capacity for novelty of form in the final prehension that is an actual entity. Form here means both structural and behavioural aspects of systems, or, as in Goldsmith, their abstract spatial and the temporal dimensions. As this capacity is greater in complex nexūs than in simple ones, complex ones are more alive than simple ones. With simple entities like an atom, the occurrence of novelty is rare, and yet it appears that atoms have evolved over time which argues for occasional novelty. They are nearly lifeless, but not completely so.

If life is a formative element of experiencing as argued in Chapter 1, then actual entities are living beings. As a rough analogy we may say that it actively takes into itself raw materials (data) from its environment, processes them and produces a finished individual (an actual entity). It is born, grows, matures and dies. Its remains (a datum) are recycled into new lives. Even the simplest

[21] Whitehead does recognise 'formative elements' in the creation of his actual entities. These are 'eternal entities', 'God', and 'creativity'. These terms will be developed as we proceed with the exposition of his system. As will be seen, they are sub-notions of the notion of causation which is one of the set of 'formative elements of thought' which I proposed in Chapter 1.

episode, say an electron or proton, is an organism. It is an organism because it exhibits life, and life, we might say, is the primeval force which sets the creative process in motion and keeps in motion. There are no doubt differences among episodes in the degree of 'liveliness', or 'livingness', that they exhibit. Liveliness appears to increase with the complexity of its form. An electron is as much alive as one that brings forth an ecosystem, though seemingly less intensely. Life is also a 'brute fact'.

5.3.5 The world

'The world' of Whitehead's cosmology is a vast nexus of all individual actual entities and is itself an actual entity. It is the most extensive of all actual entities, both spatially and temporally. Yet it is a constituent of every actual entity, however small or large. Every entity is what it is because it is, ultimately, a part of the world. Every actual entity sees itself as a part of a world, and ultimately understands itself only because of that world. 'The world' is an ingredient in every actual existent.

Two human actual entities may compare notes and find that their worlds are mostly similar, but also different in some details. This is because each has a relative view: a particular position in it and a particular function in contributing to the maintenance of its form. Neither doubts that it is one and the same world. Two electron actual entities, and also two earthworm actual entities, or two ecosystem actual entities, or two galactic actual entities, sharing notes come to the same conclusions. But an electron actual entity cannot compare notes with a human actual entity because they occupy different levels in the cosmic hierarchy

This rendering of Whitehead's definition of the world appears to be congruent with Goldsmith's Gaian hierarchy in essence, even though the extensiveness of the Gaian hierarchy is limited – presumably because the concept is more readily grasped when

presented as a physical metaphor. The Gaian hierarchy is only a part of the world hierarchy.

5.3.6 Time and space

In the section 'Actual entities' at the beginning of this section, nexūs were said to be of two types, 'temporal' and 'shared-characteristic'. Whitehead refers to shared-characteristic nexūs as 'spatial nexūs'. This seems appropriate considering that he was visualising actual entities solely as physical, and because thoughts, emotions, and feelings are usually described in terms of physical entities, symbolic or actual. This is a useful point of departure for a consideration of Whitehead's treatment of time and space.

> There are two limiting kinds of nexūs, one that is purely temporal and one that is purely spatial. A purely temporal nexus contains no pair of contemporary actual occasions; it is a mere thread of temporal transition from occasion to occasion, and the mutual immanence involved is the causal immanence of each actual entity prehending the entity immediately preceding it in the thread. A purely spatial nexus includes no pair of occasions such that one of the pair is antecedent to the other; it is a slice through time composed of contemporary actual occasions.
>
> (Sherburne, 1966, pp. 230-31)

This distinction is reminiscent of Goldsmith's temporal and spatial abstractions of the Gaian process (Section 5.1).

It is impossible to say what time and space are in themselves. In the absence of physical entities we could have no conception of space. In the absence of series of similar physical (and other types of) entities appearing one after another we could have no conception of time. On the other hand, we could have no conception

of physical things in the absence of space, nor could we have any conception of a number of similar physical or other types of things as a series in the absence of time. This is an example of what is meant when it was said (p. 14) that to be coherent a set of definitions of the seven formative elements of experiencing must 'presuppose each other so that in isolation they are meaningless'. They are 'brute facts'. Whitehead appears to agree with this.

The parts of physical entities are 'spread out' or disposed 'here' and 'there' in relation to each other. Space, then, is a system of relationships among parts of things. These relationships are described in terms of distances and direction between the parts. We might also say that empty space is where there are no physical entities, or, what is between and around physical entities, marking them out as distinct entities and making possible the concept that there are multiple existent physical entities, and not just one.

The metric of space is the difference in the distance between two selected parts of a physical thing that are in relative motion to each other in two successive experiences of a temporal nexus. In practice, this distance may be too small to constitute a separate experience, but multiples of that basic unit occurring over several successive experiences will be sufficient to do so. Thus, for example, the movement of the sun in relation to the position from which I observe it in two successive experiences is too small to register (feature in a separate experience). The movement over a complete cycle of day and night, however, does easily register. If the two experiences – the beginning and ending of a cycle – refer to a person on a globular earth, rotating in relation to a stationary sun, and by means of several calculations, the basic metric of distance becomes the circumference of the globe earth. This, when divided into a number of equal units, becomes the practical metric for use in all situations.

An event is the single occurrence of a complete process. A process implies an orderly sequence of steps, each of which may itself be considered a discrete event. In the process of creating an actual entity there are three steps or stages. These steps also occur in a causal sequence in the sense of logical continuity.

A sense of time in observing phenomena results from the appearance of a temporal nexus prehended as a single datum. This datum is either already-formed, or is freshly-created datum constructed as a prelude to the final prehension in the series of prehensions and concrescences prior to the final prehension or satisfaction stage. While the experience is seemingly of only one entity, there is the accompanying sense that that 'the' entity appeared in experiences 'prior' to the present one. The entity is experienced as having a past, and thus appears to be a relatively enduring. At the same time, there arises the anticipation that it will appear in subsequent experiences, that is, that its endurance will continue into the future.

The sense of time is heightened when, in successive experiences in a temporal community, the relative positions of various parts of the thing experienced change. In other words, the parts seen to 'move', as in, for example, the temporal community of a shooting star in the night sky. The shooting star is a part of a view that includes several actual stars. Its position changes in relation to those stars; a split second ago it was there, and now it is here. The shooting star is perceived as transiting a series of 'positions' smoothly with no apparent discontinuities or jumps. Of course, there are jumps, for the 'motion' is really composed of separate experiences strung together. Actual entities do not move.

If a given part of a thing moves in a regular, repetitive manner its relative motion forms the basis for portioning what is otherwise only a vague sense of the passage of time. In other words, a

repetitive movement, such as that of the sun in relation to the horizons, becomes a basic metric.

The sense of space and the sense of time are private to each actual entity. There are no common 'receptacles' in which all actual entities are placed. This can be illustrated in the case of time by the following example. Two atoms, 'a' and 'b', each pursues its own private 'thread of temporal transition' independently of the other. When they meet and combine to form molecule 'X' their time lines or threads run parallel to one another. Whitehead says that they are in a 'unison of becoming'; they are contemporaries and in this sense they share a common time line – which coincides with the thread of 'X'. But when 'X' molecule breaks up, 'a' and 'b' go their own ways again, each follows its own time line. They are no longer contemporaries. In the largest actual entity, the world, the time lines of all actual entities meet, and they all become contemporaries. In this sense, and only in this sense, can there be said to be a common time line for all actual entities.

A similar line of reasoning can be developed in the case of space. The sense of space is that of the larger entity in which it finds itself. It shares this space with all the other parts of this larger entity. They are 'spatial contemporaries', as it were. In the final world entity, this sense of space of each of the entities in the entire hierarchy expands to that of a common 'world space'.

Some commentators on Whitehead's cosmology consider that there is a problem with his concept of time. They say that the concrescence phase of the process of the creation of an actual entity is not in time, and yet it is said to be a process. I do not consider this a problem. In describing the process of concrescence, I suggested the analogy of struggling to create a new concept. In that experience there is definitely a sense of duration, and of its division into stages. This process is the creation of a thought entity. If we accept thoughts as a species of actual entity, which I have

urged, then this analogy is a very apt analogy of the process of creating an actual entity – in slow motion, as it were. From this point of view the process is in time, the same time that is marked out by the successive appearances of entities in a temporal nexus. It is a sub-division of the time units marked out by the successive appearances of actual entities.

5.3.7 Causation

Whitehead in *Process and Reality* employs the concept of causation as immanent in actual entities and not imposed on them (see Section 3.5 for definitions). He recognised the occurrence of novelty in the outcomes of the process of creating new entities, but does not ascribe it to chance, or say that it is a reason to abandon the notion that everything that happens does so for a reason. Neither did he have recourse to the concept of 'statistical mechanics' as mainstream 20th-century scientists did. His concept of causation will be described and examined in this section.

According to Goldsmith, as was said earlier, the structure of an entity is determined by the place it occupies, spatially and temporally, in the whole of which it is a part. Ultimately its structure is determined by its place in the entirety of the Gaian hierarchy. This is congruent with Whitehead's conception of causation. He did not go beyond this to suggest a possible causal mechanism.

Sheldrake proposed a specific causal mechanism - morphic resonance - but it cannot be the whole story. His concept needs a larger context to make it intelligible. Moreover, his concept of morphic resonance was found wanting in that, while it provides an explanation for the generic forms of entities, it fails to explain their individual features, that is, those features that distinguish one entity from another among those with a common generic form (e.g., Laxmi as a particular cow). Whitehead's conception overcomes this problem as well as providing the larger context which Sheldrake's lacks.

Whitehead has introduced his conception of causality in the following passage:

> An actual entity has a threefold character: (i) It has the character 'given' for it by the past; the 'objectifications' of the actual entities in the actual world, relative to a definite actual entity, constitute the efficient causes out of which that actual entity arises. (ii) It has the subjective character aimed at in the process of concrescence; the 'subjective aim' at 'satisfaction' constitutes the final cause, or lure, whereby there is a determinate concrescence. (iii) It has the superjective character, which is the pragmatic value of its specific satisfaction qualifying the transcendent creativity; that attained 'satisfaction' remains as an element in the content of creative purpose.
>
> (Sherburne, 1966, p. 30)

Though he has taken the terms efficient cause and final cause from Aristotle, he has defined them somewhat differently than Aristotle did. Whitehead's 'efficient cause' accounts for the initial inputs (prehensions of data from the past, or of actual entities in their superjective character), the dynamism of the process of fashioning these inputs into a final new actual entity in the present, and the form of that new actual entity. In Aristotle's concept of causation these three are, respectively, what he termed the 'material', 'efficient' and 'formal' causes of entities. It seems to me that Whitehead's concept of causation would be improved if he had adopted all four of Aristotle's causes, material, efficient, formal and final.

In Whitehead's conception of causation, the initial inputs to the process of the creation of new actual entities, and the forms that these will ultimately assume are provided by what has been termed the 'common, cosmic, causal agency', the 'Great Ordering

Oneness', and the 'Gaian hierarchy'. Whitehead's term for this is 'God'.

> God is an actual entity, and so is the most trivial puff of existence in far-off empty space. But, though there are gradations of importance and diversities of function, yet in the principles which actuality exemplifies all are on the same level. ...The presumption that there is only one genus of actual entities constitutes the ideal of cosmological theory to which the philosophy of organism endeavours to conform. ...God is not to be treated as an exception to all metaphysical principles invoked to save their collapse. He is their chief exemplification.
>
> (Ibid., pp. 225-6)

To account for the two functions assigned to God, namely supply of forms and inputs, Whitehead says that God has two aspects, what he terms his 'primordial nature' and his 'consequent nature', respectively. His primordial nature is a collection of 'eternal entities'. These are abstract organising principles that are responsible for the general forms of actual entities, and which limit the possibilities of new actual entities for novelty. The most obvious of these are numerical, for example unity, duality, four-foldness, seven-foldness, and so forth. Other examples are the emotional organising themes that C. G. Jung termed 'archetypes' (for example, the 'Mother' archetype). His consequent nature is the store of all actual entities in the past (data), the store from which data can be accessed by newly-forming actual entities. The participation of the contents of both these realms, and their interactions provides the wherewithal to the process of world continuance and evolution. These realms are non-temporal and non-spatial. They reside in each and every actual entity and nowhere else.

It is now possible to see how Goldsmith's concept of 'models' of the whole inform all parts at all levels of the Gaian hierarchy and ensure conformity of parts to the whole, and how Sheldrake's morphic fields and morphic resonance are an expression of the data of past actual entities interacting with eternal entities prehended by actual entities being newly created.

5.3.8 The Process and Reality worldview – a final assessment

It is my view that the worldview suggested by Whitehead could be the starting point for constructing a viable alternative science in this century. I say 'starting point', because as it stands I think it is in need of some important adjustments. I have already suggested what these are and my reasons for suggesting them. Briefly, they are:

1. Four types of actual entities should be recognised. Whitehead's use of the words 'feeling' and 'thought' in describing the process of creating an actual entity is confusing. Where do these feelings and thoughts come from? Perhaps their use in this context is unnecessary. Perhaps a more adequate concept of the subject or observer would help resolve this problem.

2. The subject, or observer, and life should be recognised as inputs to the process of creating an actual entity, that is, they should be recognised as formative elements of thought. This would do away with the need to invoke the concept of emergence.

3. Life should be recognised as what initiates and sustains the creative process. Whitehead has not explained why the process proceeds, confining his attention only to how it proceeds.

4. The sequence of phases of the creative process – prehension, concrescence and satisfaction – could be seen to occur in the same time as the appearances and disappearance of actual existents – if the concept of the observer were adjusted; that is, if the observer was assumed to be present during the process, witnessing it.
5. The concept of the process of creating new actual entities could be improved if it was framed in terms of Aristotle's four causes.

If Whitehead's worldview were to be accepted as the foundation for a new science, scientists in this century would still have to build a superstructure of methodological procedure, or an experimental protocol, on it. There are hints of such an alternative protocol in both Goldsmith's and Sheldrake's books, but for a definite formulation of it, I suggest turning to the work of Albert Howard.

5.4 Nature's farming

Albert Howard was a British agricultural scientist who worked in India for three decades at the beginning of the 20th century, and for short periods before that, in the West Indies and Britain itself. He was born into a farming family and as a result acquired a good grounding in agricultural practice. He studied general science at Cambridge University and also obtained a diploma in agriculture. When he began his career it was as a specialist in plant diseases, and more specifically in fungal diseases (mycology). But he was by nature a generalist and took a broad view of the problems of agriculture. Fortune and his own determination enabled him to go his own way, and as a result he made a unique contribution to agricultural science as a whole. In this section I will describe this contribution, and reflect on its significance.

His contribution was two-fold. The development of new wheat varieties in India led to greatly increased wheat yields. By 1925 these new varieties of wheat were grown in more than 10 million hectares. Largely on the basis of this work he was made a Fellow of the Royal Asiatic Society in 1928, and in 1930 he received the Barclay Memorial Medal of that society. He was knighted in 1934, and made an Honourable Fellow of the imperial College of Science in 1935.

The second aspect of his work was far more significant and enduring. Following his own inclinations he looked at agriculture as a whole and addressed its problems from what we would today call a systems point of view. He described this point of view and developed a research methodology deriving from it. Moreover, he demonstrated the effectiveness of this approach in the context of everyday, practical farming. He described all this in his book *Nature's Farming: An Agricultural Testament* published in 1940. It has become a classic, reprinted continuously to the present day. It inspired and continues to sustain the organic or natural farming movement worldwide. This aspect of his work and its implications of human health and economics has been ignored by the scientific establishment. In preface to his book Howard wrote:

> The purpose of this book is to draw attention to the destruction of the earth's capital - the soil; to indicate some of the consequences of this; and to suggest methods by which the lost fertility can be restored and maintained.
>
> (Howard, 1940, p. ix)

He begins by introducing the concept of 'Nature's farming', and insists that for successful, sustainable agriculture we must endeavour to follow Her example. He reasoned that as undisturbed natural systems are stable over long periods of time, we should

imitate as far as possible the original, natural ecosystem of the particular locality where we farm. He drew our attention to four principles that he perceived to be operative in such systems, using a forest as an example. These are, in his own words, (pp. 1-4):

1. 'Mixed cropping is the rule.'
2. 'The soil is always protected from the direct action of sun, rain and wind.'
3. 'The forest manures itself.'
4. 'Crops and livestock look after themselves.'

In elaborating on these brief definitions he uses the other terms and definitions such as:

- 'Nature's round'
- The 'wheel of life'
- 'The wheel of life is made up of two processes - growth and decay. The one is the counterpart of the other.'
- 'We must adopt a synthetic approach and look at the wheel of life as one great subject and not as if it were a patchwork of unrelated things.'
- 'All the phases of the life cycle are closely connected; all are integral to Nature's activity; all are equally important; none can be omitted.'
- 'We must consider the wood, not the trees.'
- 'living soil'

In the terminology of ecology, a science that developed largely after Howard's time, his four principles can be reworded to:

1. Maximum biodiversity
2. Continuous soil cover. Exposure of the soil surface to rain, sun and wind causes deterioration through rapid

oxidation of soil humus, loss of biological activity, leaching of soluble minerals and soil erosion.

3. Complete circularity in the flows of biomass, energy and minerals within the ecosystem.

4. Adaptation of species to the local ecosystem to ensure maximum, sustainable biomass production. Adapted species, and mixtures of species, possess the maximum possible resistance to diseases and pests.

Understanding these principles will be easier if they are seen in relation to the pattern of ecosystem evolution. As a natural ecosystem matures, or evolves, it displays an increasing complexity and stability until it reaches an adult or 'climax' stage. Thus for a given ecosystem, biodiversity (both in the soil and in the above-ground flora and fauna) is maximum at the climax stage. Biomass production (that is, the annual production of primary, plant biomass in terms of tonnes of dry matter per ha) is also maximum, and year-to-year fluctuations in production are minimum. Ground cover is complete in a mature ecosystem (closed tree canopy, undergrowth and a ground mat of decaying organic matter) and therefore the rate of soil loss through erosion is less than the rate of soil formation (or deposition), resulting in a gradual increase in soil depth. During the maturation process an ecosystem builds up in carbon content (in both the soil and in above-ground biomass) to a state of equilibrium in which carbon loss in respiration is balanced by carbon gain from photosynthesis.

Individual species evolve along with the ecosystem of which they are a part, until at ecosystem maturity each is adapted to the conditions of the system and each contributes something vital and unique to the structure and functioning of the system. A mature ecosystem shows a high degree of resistance to the invasion of foreign species/ varieties.

If a mature ecosystem is interfered with by human beings it regresses. With regression there is a loss of complexity and stability. Biomass productivity declines, carbon balance turns negative and soil erosion may accelerate. Owing to the changed conditions, foreign species/ varieties easily invade the ecosystem, establish themselves and bring about further changes in the system.

Thus, when farming is taken up in a previously undisturbed, mature ecosystem it inevitably degrades the system. This degradation is the price to be paid for an increase in the proportion of the total ecosystem biomass production that can serve direct human needs (for example, more food, less wood). However, a farmed ecosystem can be stabilised at an intermediate stage; it need not continue to degrade further after the original settlement. To achieve this requires knowledge, skill and constant effort on the part of the people of the farming community. They must understand and preserve/ imitate the essential features of the intact mature ecosystem. If they succeed, they produce sufficient quantities of biomass of all the types they need while preserving sufficient biodiversity to buffer the system, ensuring continuous soil cover and maintaining circularity (that is, the recycling of all organic matter to ensure that the carbon content of the system does not decline). They are circumspect about introducing foreign species/ varieties into their farming system.[23]

Translated thus into an ecological idiom, it will be obvious that the concept of 'Nature' is similar to Goldsmith's Gaian hierarchy. His capitalising the word 'Nature', and by occasionally using the term 'Mother earth' suggests the same attitude as we found in traditional non European cultures and in European culture itself before the 17th century (e.g., '*Prithvi*' in Indian Vedic culture and 'Gaia' in ancient Greek culture).

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[23] This and the foregoing five paragraphs have been adapted from Jackson, 2013 a, pp. 53-56).

Given this conceptual orientation to the task of ensuring sustainable agriculture, and the task of restoring it where it has already been lost, Howard moves on to indicate how an agricultural scientist must conduct his or her research. First, he or she must construct a general model of an agricultural ecosystem. This model will be a dynamic model, that is, a model depicting both the temporal and spatial dimensions of the system. This cannot be done mathematically or pictorially. It must be done conceptually. Since the details of the system, that is, the entities and events that occur as parts of the system, are innumerable, they cannot all be taken into account. Therefore it is necessary to identify a few of the more prominent entities and events (or sub-processes) and use them to characterise the system as a whole. These can be termed 'indicator' entities and events. This is what Howard did when he identified his four 'principles'. These together would, he thought, give the scientist a 'picture' of an agricultural ecosystem in terms of which its current state of 'health' could be judged. A healthy ecosystem would be one which adhered closely to this picture or model.

Next, he or she must focus on a suitable ecosystem unit, preferably one which he or she knows intimately 'on the ground', so to speak. Where traditional rural communities are distinct entities, as they still are throughout Asia and Africa, this unit will be the village since some of the village land and all its water are common-property resources. Where farming has become mechanised and extensive, and land is entirely individually owned, the unit will be the individual farm. These will be treated as village and farm ecosystems, respectively. Domestic animals and human beings (families and village communities) are parts of the agricultural ecosystem. The overall state of the ecosystem is then to be assessed in terms of his or her model to ascertain to what extent Nature's requirements are observed. Where they are not being observed, remedial measures are to be devised, measures

designed to bring the system back to health as quickly and gently as possible.

This procedure amounts to an alternative research protocol in broad outline. Howard added a number of more detailed features, or elaborations of the general features mentioned above. These can be gleaned from his critique of modern agricultural science. He devotes a full chapter to this (Chapter XIII). He begins his critique by saying:

> The vast fabric of agricultural research must now be examined in order to determine whether effective contact has been maintained with the problems of farming.
>
> (Ibid., p. 185)

In discussing the mineral nutrition theory of agricultural chemist Justus von Liebig (published in 1840), which he disputed because he saw that Liebig has not realised the importance of humus in plant nutrition, he pointed out:

> He [Liebig] also failed to realise the supreme importance to the investigator of a first-hand knowledge of practical agriculture and the significance of the past experience of the tillers of the soil. He was only qualified for his task on the scientific side; he was no farmer.
>
> (Ibid., p. 186)

He then turns his attention to the institutional aspects of agricultural research. He notes:

- There is a fragmentation of agricultural research effort into numerous separate disciplines – soil science, agronomy, horticulture, plant pathology, animal science, and so on, and its division into separate administrative units – institutes, colleges, departments, and sections.

- In an attempt to overcome the isolation and lack of a wider focus, efforts are made to foster co-operation by the formation of *ad hoc* cross-disciplinary committees.
- Team work is favoured over individual effort.
- Quantification is insisted on.

His comment on specialisation: 'Teamwork offers no solution for the evils which result from fragmentation of a research problem. The net woven by a team is often full of holes. ...the consequences of fragmentation and specialization is loss of direction (Ibid., pp. 198-9).' He asks: what would have been the fate of Charles Darwin and Louis Pasteur if they had been forced to work in one of these institutes? And: 'Can a mutually interacting system, like the crop and soil ...dependent on a multitude of actors which are changing from week to week and year to year, ever be made to yield quantitative results which correspond with precision mathematics (Ibid., p. 200)?'

In seeking the cause of a particular problem, say the occurrence of a disease in a particular crop, look to the field (soil-cropping system) as a whole, and not to the disease organism. The cause will be found to be an unhealthy field system, and beyond to unhealthy farm and village ecosystems. This state of poor health will be indicated specifically as a departure in some specific way(s) from the 'model' of the system one has constructed. The solution to the problem will be to design a way, or ways, of restoring the field and farm or village ecosystems to health - that is, bring it closer to the functioning of the system described in one's model. Trying to solve the problem on its own level by, for example, spraying the plants with poisonous chemicals, might appear successful in the short run, but in the long run will cause a further deterioration in the health of the field and farm or village ecosystems.

This will be indicated by unexpected, and apparently unexplainable, 'side effects'.

When the 'cause' of the disease has been identified as a violation of one or more rules of Nature's farming, appropriate remedial measures may be designed and applied. If our model is adequate, and our remedial measures effective, the disease condition will be less likely to occur in the future. Or, if it does occur, it will be in a milder form. The remedial measures must be tested by putting them into practice in the same ecosystem in which the problem was observed. If they are not effective, then we must go back to square one and start over again.

Howard created a new research institute at Indore where he could pursue research in his own way. There he proceeded to demonstrate the effectiveness of his protocol. All this has been described in his book.

My purpose in reviewing Howard's work has been to ascertain whether his research protocol might dovetail with the theoretical framework of Goldsmith, Sheldrake and Whitehead, and if so, to what extent. I hope I have demonstrated that there is indeed a high degree of dovetailing. If this is so, then it will be worthwhile attempting to generalise his protocol to make it a suitable guide for scientific research in all fields. Not only would it need to be spelled out in more general terms, but also formalised and systematised. It should be possible, I think, to create one protocol for all research problems, if its terms are sufficiently general. No doubt, scientists will then elaborate it in ways that seem necessary to the type of problems they are investigating. A common core protocol will help in overcoming the fallout from the fragmentation promoted during the reign of modern science.

To this end, I outline my tentative suggestions for a common, over-arching research protocol.

1. The world is made up of four independently existing types of actual entities. All alike are legitimate entities of scientific enquiry. These are physical entities, thoughts, emotions and feelings.

The methods of studying all these actual entities are the same in general, but vary somewhat in practice.

2. Actual entities, the observer, life, time, space, causation and coming to know are all formative elements of experiencing. They are to be accepted as such.

Attempts to explain what they are in themselves or how they come to be are misplaced and misleading.

3. The first step in the process of scientific enquiry is to describe the system to be investigated. This description must cover both the spatial and the temporal dimensions of the system, that is, it must describe the entities involved and their interaction (events).

All entities and events are dynamic systems of parts interacting in time and space. The only adequate way of describing systems is in terms of abstract models, that is, as thought entities. Visual maps, geometrical diagrams, algebraic equations and computer simulations are not capable of representing the essential nature of a system or process and should not be attempted; they can only mislead.

It is not necessary or worth while to describe an entity or event in terms of its constituent parts, since its own form (temporal and spatial) does not determine how it appears or what it does.

4. To describe the forms of systems, a few of their most prominent or easily identified features (entities and events) must be identified and tracked. The resulting pattern they weave is the 'model' mentioned at 3 above.

The reason for this rule is simply that it is impossible to identify and then represent all the myriad details of any system.

5. The form of the system represented by a model is an explanation for each of its parts being as it is and doing what it does. It is also a guide in determining why any particular part of the whole system is dysfunctional.

There are thus two different types of research problem: the aim of the first is discovery, that of the second diagnosis. The first leads to an understanding of the system, and of the ways in which its parts might be modified within the limits set by its place and function in the system of which it is a part. The second guides the scientist in devising measures to restore the part(s) to health (to functioning in harmony with its place and role in the whole).

6. Remedial measures must be tested in practice. This must invariably be done in the situation in which the problem was observed.

Testing is necessary because the model being followed may be inadequate. Testing under artificial conditions in laboratories and other research facilities is not permissible. The results of testing under such conditions are invariably misleading – in the long run.

7. The scientist is a person, the observer of phenomena. He or she is in no way independent of or detached from what is observed.

The person is a large, complex nexus of physical, thought, emotional and feeling entities. This nexus is a part of the Gaian hierarchy, just like the nexūs he or she observes. The forms of all are determined by their place in the hierarchy. The process of

observing is part of the larger process in which it occurs. The understanding of what is observed through scientific enquiry, and the devising and testing of remedial measures are all activities within the Gaian hierarchy. Remedial measures are Gaia's acting through the scientist.

8. An essential qualification for a scientist is intimate, hand-on experience of the system of which the particular phenomenon he or she wishes to investigate is a part.

Without such experience the scientist can become a specialist straight away, whereas all scientists first of all should be generalists. This will also counteract the tendency for research institutions bureaucracies to become fragmented.

9. Human interventions in systems, natural or human-made, must be gentle so as not to distort the systems in terms of their essential structure as revealed in their models.

Interventions that abstract a part of the system, or introduce a foreign element into it are not permissible. Such violent interventions can only, in the long run, impair the health of systems, giving rise to violent reactions or killing them altogether.

10. Sick systems must be healed before further interventions are contemplated.

Virtually all natural systems and all human-created systems on our planet earth are today sick. The highest priority in scientific research will therefore have to be given to the questions of why they are sick, how they sickened and how they can be healed. The functioning of a healthy system will in such circumstances have to be inferred/ intuited from studying sick systems. Systems

have to be made healthy again – or, more accurately, helped to heal themselves – and then ways found to keep them that way.[24]

Protocol items nine and ten are to be observed by scientists in their role of inventors of new technological applications of their research findings.

To understand the rationale for this alternative protocol, scientists must be aware of and understand the foundation on which it is erected – that is, the set of the assumptions or worldview of which it is an expression. Twentieth-century mainstream and 'new' scientists are mostly unaware of the assumptions underlying and legitimising their research protocol. They simply copy the procedures used by scientists who have conducted experiments that have yielded results that are tacitly approved of by the contemporary scientific community. There are assumptions at work, but in the 'background', so to speak; the scientists are unaware of them. This accounts for the inability of these scientists to question effectively the protocol they have inherited.

To remedy this situation in the future and make science more responsive to changing world conditions the training of young scientists should include exposure to the history of scientific thought and practice. This is essential if they are to have an adequate perspective on the work they will do later. From this they will gain an appreciation of the role of assumptions in the scientific enterprise, their own and those of scientists in other times and cultures. Texts such as A. E. Burtt's *The Metaphysical Foundations of Modern Science* (1932), Herbert Butterfield's *The Origins of*

[24] Clumsy human interference in the next larger system to the earth ecosystem, the solar system, is rapidly increasing. So far, however, the scale of this interference is small and the inherent robustness of all natural systems is sufficient to neutralise it – like a healthy human body neutralises invading disease organisms, within limits.

Modern Science (1957) and Arthur Koestler's *The Sleepwalkers* (1959) could be required reading. For something more recent, the present book might serve.

5.5 Some reflections

The achievements of the pioneers of alternative science described in this chapter can greatly expand the boundaries of science. The assumptions made by mainstream and 'new' scientists severely limit the range of phenomena that can legitimately be investigated. Most notable of these are the impossibility of studying thoughts, emotions and feelings as entities in their own right. Another is the freeing of the scientific enterprise from the Pythagorean orientation in which it is thought that the only way of describing phenomena is in terms of mathematics, that is, numbers applied literally. This will forestall further fruitless work such as Einstein's attempt to unify all scientific descriptions in one determinant set of mathematical equations, and the attempt to describe systems in terms of topological maps.

Then there is the creative linking up with the traditions of previous cultures in the legitimising of ancient concepts which now begin to appear relevant, and indeed, necessary in order to free science from the straight-jacket of inherited 17th-century assumptions. The appeal to Plato and Aristotle, and further back to Vedic and Taoist thought will have been noticed in the course of this critique.

The alternative science now taking shape unequivocally accepts the formative elements of thought as 'brute facts', simply given in experience. This would release considerable resources – personnel, time and money – now spent in such sterile enquiries as the 'origins of life', the 'mysteries of the mind' and 'the nature of consciousnesses'.

The alternative experimentation protocol suggested above will go a long way in combating the 'ivory tower' and 'pure research' mentality of modern science. It would also help prevent the fragmentation of scientific work and scientific organisations. This cannot but make science more effective in serving society and also more accessible to non-scientists. It should reduce non-scientists' credulity concerning the pronouncements of scientists, and the scientists' own inflated conceptions of the importance of their work.

This alternative science would restore some measure of the ultimate mystery, of the unknowable, to our worldview. The realisation that science is not a 'search for truth', and that there is no such thing as final truth which science will eventually discover, cannot but have a salutary effect on our lives.

Finally, there are the matters of connectedness and purpose in contemporary life. The modern worldview fosters a sense of isolation and an absence of ultimate meaning in human life.

> Man is the product of causes which had no prevision of the end they were achieving; that his origin, his growth, his hopes and fears, his loves and beliefs, are but the outcome of accidental collocations of atoms ...all these things, if not quite beyond dispute, are yet so nearly certain that no philosophy which rejects them can hope to stand. Only within the scaffolding of these truths, only on the firm foundation of unyielding despair, can the soul's habitation henceforth be safely built.
>
> (Bertrand Russell, quoted by Goldsmith, 1998, p. 161)

The alternative science outlined in this chapter seems less likely to give rise to such a nihilistic view. Those who find their yearning

for wholeness and meaningfulness expressed in the idiom of religious symbolism may come to see that there is considerable continuity of their religious symbolism with their scientific formulations. The use of the name 'Gaia' in Goldsmith's exposition, and my own reference to the Earth Goddess *Prithvi,* are instances suggestive of this possibility.

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(The first of these books was published by Palgrave Macmillan in 2008 and the remaining four by Permanent Green in 2013)

Assumptions of Twentieth-Century Science: A Critique

M.G. Jackson

Assumptions are not matters of fact but speculative constructs aimed at explaining phenomena that otherwise appear inexplicable. Examples in modern science are the concepts of gravity, inertia, chance events and photons (particles of light) formulated by Isaac Newton, Galileo Galilei, Charles Darwin and Albert Einstein, respectively. These assumptions replaced those of the Aristotelian science of medieval Europe. With changing circumstances existent assumptions may prove inadequate and even counterproductive. This was the reason for the scientific revolution of the 17th century, giving rise to modern science.

In the 20th century it became apparent to many scientists that the assumptions of that scientific revolution are no longer adequate, and are themselves in need of replacement. With hindsight, it is possible to see why this is so. The author demonstrates how these assumptions are illogical and are inconsistent with one another. These defects coupled with the need to understand the many newly observed phenomena that appeared in the 20th century, rendered modern science increasingly irrelevant.

He then goes on to critique in the same way the alternative assumptions suggested by 20th-century scientists. Many of these are also found wanting, but a few are more promising. He argues that using the latter it would be possible to construct in this century an alternative science that would enable us to deal effectively with the environmental, social and economic problems which are, in large measure, the results of the applications of modern science.

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